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WORLD HEALTH ORGANIZATION

In this issue

- *" There is no doubt," states a recent report by a WHO consultant, " that the health centre scheme as it is developing in Kenya is a major contribution to the solution of some exceedingly difficult problems in health service provision in less developed countries" (see page 323).*

- *In its early days, sanitary engineering played a prominent part in the control of gastro-intestinal diseases. Over the past sixty years, its scope has widened enormously, and the need for sanitary engineers has grown in all parts of the world. National and international trends in the training of sanitary engineers are described in the article beginning on page 329.*

- *Of the ten million or more people in the world afflicted with leprosy, less than 5 % are properly treated in institutions, less than 20 % treated at all ; and it has been estimated that a quarter of all leprosy sufferers acquire some disability. Much can be done for the rehabilitation of those with disabilities that is not being done at present (see page 348).*

- *During the last few years WHO has collected data on dental schools and dental education. The result is a* World Directory of Dental Schools *which has just been published. Among the trends discernible is an increasing emphasis on public health dentistry and preventive dentistry in dental education. Of the 70 countries for which information is available, not less than 21 have public health courses in their dental schools, 21 have courses in preventive dentistry, and 8 have both. It is interesting to note that only four European countries take an interest in the preventive approach. This may reflect either a less urgent need because of a more favourable ratio of professional dental personnel to population in Europe than elsewhere, or perhaps merely a more conservative approach to dental training (see page 338).*

- *The figures are impressive : as many as 200 000 roundworm eggs, 50 000 hookworm eggs, and 50 000 whipworm eggs may be contained in the average stool from an individual harbouring a pair of worms of each of these species. The chances of infestation, the extent of the problem, and the methods of control of soil-transmitted helminths are discussed in a new WHO publication (see page 345).*

- *While the problem of providing health services in large factories in Europe is well on the way to solution, most of the smaller factories still lack health services on or near their premises. More than 90 % of factories in some European countries employ less than 100 workers (Italy, 95 % ; Belgium, 96 % ; Sweden, 92 %), and in most the proportion varies between 80 % and 90 %. Of the 220 000 factories in the United Kingdom, 150 000 employ 10 or fewer workers (see page 352).*

HEALTH SERVICES IN KENYA*

The health centre system, as developed in Kenya, may prove to be a valuable contribution to the solution of health service problems in the less developed countries. It is described in this article against the background of Kenya's health needs and difficulties.

The area of Kenya is approximately the same as that of France, but the estimated population is only some 6.5 million. In the northern arid parts the population is scanty (2-4 per square mile); in the warm, humid Coastal Province it is 18 per square mile; but in the cool and fertile highlands (which range from 3000 to 10 000 feet in height) it is 70-170. About four-fifths of the population, therefore (according to the 1948 census), is concentrated in less than one-fifth of the total area. There are only two large towns, Nairobi and Mombasa. Of the 25 000 miles of road only 600 are metalled, and in the rainy season all but the metalled roads are liable to become impassable, with obvious effects upon communications and the transport of the ill or injured. Agriculture is the chief economic activity, coffee, sisal, tea, and pyrethrum being produced for export; most of this production is at present in European hands. African farming has been hindered by the custom of paying for brides with cattle (too many cattle are therefore kept and the pasture is over-grazed), and by the division of landholdings at death among the heirs; but in recent years a policy of land consolidation has been adopted, often with great success in increasing productivity.

There are several main tribes, and, although the old tribal structure is breaking down, some customs and beliefs remain and may have their effect on health. Thus in some classes of the community fish, eggs, and chickens are forbidden as articles of food; and ancient taboos led to the failure of a particular health campaign, the colour red—which has a traditional and undesirable significance—having been used on the posters. Problems are also raised by tribal differences : there are difficulties about appointing other than Kikuyu health workers, say, to Kikuyu districts, or Luo workers to Luo districts.

Education is not sufficiently advanced to produce all the recruits needed for health and other services. About 1100 pupils finish their secondary schooling each year, and they have to be shared out among all the services and professions clamouring for them. As long as the members of the district councils are themselves barely more than literate, it is not to be expected that they will grasp the full implications of health service development or appreciate its less obvious benefits to health. Health education is also likely to suffer.

There are some 6500 Government hospital beds in Kenya, and some 2500 beds in hospitals maintained by missions, European tea estates, and private bodies. Maternity hospitals are provided and maintained by the local authorities, who also administer all non-hospital medical services. The local authorities are the City Council of Nairobi, the municipal boards of five other towns, the African district councils over most of the country, and six county councils in the European-settled areas. The Government medical officer of the district hospital ir almost invariably appointed medical offices of health to the African district council; Government nursing sisters who are qualified midwives serve in the maternity units of the African district council; and Government health visitors and health inspectors also serve the district council part-time. The Government and district services are thus closely linked.

* WHO prepared a report on long-term health planning for the ninth session of the United Nations Committee for Information on Non-Self-Governing Territories. This report discussed the principles of planning for health in these territories, but gave no concrete examples, suggesting that practical studies of specific territories be carried out later. In accordance with this suggestion, Dr J. D. Kershaw, Medical Officer of Health, Colchester, Essex, England, visited Kenya in October 1960 as a WHO consultant. This ar icle is based on his report.

Health needs

The commonest major disease conditions as reported from the districts are, in order of frequency: tuberculosis, malnutrition, malaria, venereal diseases, parasitic diseases, dysentery and enteric fevers, and yaws. The statistics from the hospitals place malaria at the top, followed by lobar pneumonia and broncho-pneumonia, venereal diseases, dysentery and gastro-enteritis, pulmonary tuberculosis, and the parasitic diseases. The high place occupied by pneumonia is possibly due to the rapid changes of temperature in the highlands. Malaria is seasonal in the malarial areas, and the staff in charge of insect-borne diseases, after various experiments, have come to the conclusion that the best policy is to reserve mass spraying for localized epidemics and encourage the population to take antimalarial drugs—the cost of the drugs being more than balanced by the saving in manpower.

Lacerations and fractures account for a relatively large number of hospital cases—although, in the relative absence of industries, industrial accidents are few, and there is little automobile traffic.

Tropical and subtropical countries in the past and even in the present have often been faced with specific disease problems of such urgency and gravity that they have had to concentrate all their resources on their solution before turning to the task of building up their health services. Kenya has been fortunate in not being among them. Its health situation is somewhat comparable with that of the highly developed countries in the nineteenth century; and it has the advantage of having twentieth-century knowledge and drugs available to it. But it is economically comparatively poor, and sadly short of medical and nursing staff, of hygienists, medical technicians, and medical auxiliaries.

The drift to the towns is a feature of life in Kenya, as elsewhere in modern Africa. Housing in the towns is inadequate and lacks sanitation. Water supplies vary according to the part of the country, and present the usual problems of inaccessibility and pollution. In an attempt to deal with the problem of excreta disposal, the health departments have tried to introduce pit latrines, with variable success. In rural areas, the problem of food hygiene is mitigated by the use of locally produced carbohydrates as staple foods, carbohydrates being less open than other foods to heavy bacterial and parasitic contamination; but as the country progresses towards a money economy the commercial handling of foods increases, more proteins are consumed, and even the smallest villages are beginning to have their shops. The likelihood of contamination is thus increased and presents a growing danger to the public.

Health services

Hospital beds are insufficient, particularly for the African population. Special hospitals are: one large mental hospital, one chest hospital, five maternity hospitals and two infectious-disease hospitals. Of these, the mental hospital and three maternity hospitals are in Nairobi, one infectious-disease hospital and one maternity hospital are in Mombasa, and one maternity hospital is in Kiasmu. While hospital staff is generally in short supply, it is specially so in the pathology and bacteriology departments.

Maternal and child health

The birth rate in Kenya is probably between 40 and 50 per 1000 population, so that the number of births is between 240 000 and 300 000 annually. To cope with these there are not more than 1100 midwives and assistant midwives, many of whom work only part-time. Probably more than half the confinements take place without any skilled aid. In 1958 there were 144 deaths associated with pregnancy, childbirth and the puerperium in the Government hospitals, and it is to be assumed that there were others as well outside. The health centres deal with normal midwifery, the hospitals with complications; the latter admitted an average of one abnormal to every four normal cases.

Eclampsia is uncommon, but obstruction is not, pelvic deformity and contracture occurring frequently among the Kikuyu,

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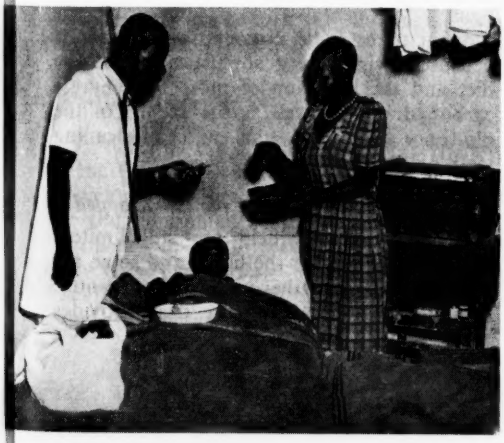


Butere health centre, Kenya

1. A class of mothers receives instruction in hygiene and nutrition.
2. The health centre staff go out into the villages to tend patients and hold open-air classes.
3. Expectant mothers await antenatal talks at the clinic.
4. Part of the staff at work in the clinic.
5. One of the 3000 people served each month by the health centre.

probably because of the custom of carrying heavy loads on the back suspended from a strap round the brow. Obstruction is not usually helped by the custom in some parts of the country of using local drugs to stimulate contractions of the uterus. Anaemia is prevalent. The idea of having a midwife to help at labour is rejected in places as being unnecessary if all is well. On the other hand, the idea of the antenatal clinic is slowly taking root; attendances are increasing, and the main obstacle is the lack of midwives.

Accurate figures for infant mortality and morbidity are not obtainable, but as the mortality rate in Nairobi in 1959 was 103.8, it is reasonable to assume that in other parts of the country it is much higher. From the deaths that take place in hospital, it would appear that upper respiratory infections and malaria are the most serious diseases, whooping cough being particularly lethal. Another important cause is gastro-enteritis.

At present the idea of the well baby clinic is quite foreign to the rural population. Moreover, many women work, either on their own land or for someone else, and this is likely to make them reluctant to go to a clinic if the child appears well. Only when the child is unwell is the mother in the least interested in bringing him to a clinic; but there is a growing feeling that it is better to bring him with minor or early illness rather than wait until major illness makes it necessary to take him to hospital. Because so many women work, children's crèches have been set up in certain areas, run by the district councils but with supervision by officers of the British Red Cross Society. The staff are selected local women.

A start has been made on programmes for the training of mothers in parentcraft.

The health of the school child

There is no regular, periodical inspection of schoolchildren, or care of those found to be suffering from some disease or disability. Where health centres are well developed, however, the health centre team while on its rounds may inspect the local school and examine the children. As a rule the hygiene of the school is fairly adequate, with a water supply and pit latrines that enable the pupils to practise the simple rules of hygiene that they are taught. But the training of the teachers in health education is usually wanting, and health centres are not to be found everywhere.

Food and nutrition

Most children are breast-fed up to as much as two years old, but carbohydrates are early used as a supplement. The Masai live mostly on cow's milk, meat, and blood, but the other tribes are mainly vegetarian, eating cereal flour, maize, millet, and bananas, supplemented by beans, green vegetables, cassava, and sweet potatoes. Protein deficiency is therefore common, and the hospitals receive a steady trickle of cases of kwashiorkor. The general effect, however, is reduced physical development and lowered resistance to disease.

Attempts to improve nutrition take three forms. Specific food supplements are provided—UNICEF dried milk, for example, and powdered protein derived from meat. Health education is undertaken to dispel ignorance and modify tribal customs and taboos that prevent better use from being made of soil and climate. And the Department of Agriculture is assiduously trying to develop the production of food for home consumption.

Dental health

In 1958 there were 45 registered dentists in Kenya, some of whom were retired or partly retired from practice. There is virtually no public dental service, and there are no figures for dental disease, but caries is thought to be fairly common among adults because of increasing sophistication in the diet and the inclusion of more fermentable carbohydrates, as well as the decline of the old, once almost universal, habit of cleaning teeth with a " tooth stick ".

Rehabilitation and care of the handicapped

Activities in this field are still limited. There is a school for the blind, and some are being trained in leather-work and carpentry. A voluntary society for the deaf provides

funds to supply partially deaf children with transistor hearing aids, the hospital at Nairobi gives auditory training, and two missions are developing schools for the deaf. The physically handicapped live mostly by begging. A newly formed voluntary society for the care of cripples is setting out to establish training workshops, but is hampered by the fact that most cripples have not been to school. While there are trained physiotherapy assistants in several hospitals, there are only four fully qualified physiotherapists in the whole country, and it is impossible to provide enough remedial treatment for the physically handicapped. There is a centre for making artificial limbs which may be provided free to those unable to pay for them. The problem of the mentally handicapped does not so far seem to have become very serious, the country seeming still to be in the stage at which the grossly handicapped die young and the moderately handicapped can be absorbed into unskilled work.

Health education

Clearly health education is of vital importance. Hitherto it has not achieved spectacular successes, but this is due to such causes as illiteracy, tribal customs and beliefs, a failure to grasp the purpose of visual aids, inability on the part of the average person to apply unfamiliar experiences to himself, and the widespread appeal of curative magic. The central department of health education is attempting to conduct its campaigns in the light of these findings, and in conjunction with other departments concerned, but the task is an uphill one, and material and equipment are in short supply.

The health centre

"There is no doubt," says Dr Kershaw, "that the health centre scheme as it is developing in Kenya is a major contribution to the solution of some exceedingly difficult problems in health service provision in less developed countries." Up to 1951, rural health services depended mainly upon the rural dispensaries—small centres providing limited out-patient care. The idea behind the health centre was that it should be a working base for a team of preventive and curative workers. Curative work should be done with out-patients; there should be accommodation for child-welfare, antenatal, and immunization clinics, and facilities for lectures and demonstrations in health education. But there should also be field work in the villages and homes of the people —which, it was hoped, would in due course be the main activity of the centre.

The first health centre was opened in 1951, and now 100 or so of the 300 centres and sub-centres envisaged are in operation. No attempt is made to follow a rigid pattern throughout the country, the centre being adapted to local conditions. It is situated in a large village or small town, preferably one to which people from a considerable surrounding area come to do their marketing, but also, if possible, strategically placed for access by road to the principal villages and small towns in its area. There may be one or more sub-centres in the larger villages, possibly former dispensaries integrated into the new scheme; they are visited regularly by the health centre teams.

The typical centre comprises a suite of out-patient departments, antenatal, child-welfare, and other clinics, space for lectures and demonstrations, and accommodation for the staff. Frequently there are two or three small wards, for normal midwifery cases or for patients staying a night or two for observation or on their way to the district hospital. This ward accommodation normally consists of 6 beds, though sometimes there are as many as 10 or 12; it is deliberately kept small because the health centre is regarded as a base for work among the people, and an increased number of beds would keep the staff busy in the centre and away from what is considered its essential work.

The health centres are controlled and managed by the African district councils, but are responsible to and directed by the district medical officer of health. They maintain contact with the Government hospitals through this official, who is a

medical officer on the staff of the hospital as well as the medical officer of health to the African district council. As a result, the district hospital may become the combined headquarters of the curative and preventive services of the district. The staff of the health centre is given a considerable measure of responsibility for the day-to-day work of the centre, on the principle that the best way to fit people for responsibility is to require them to accept it. The essential staff consists of a hospital assistant in general charge of the team; one or more dressers; a midwife or assistant midwife; an assistant health visitor; one or more health assistants; one or more drivers; and domestic staff. But it may be modified to suit local circumstances; in large centres, for example, it is becoming the practice to have an assistant health inspector at the centre and health assistants working under his direction, each responsible for one or more villages and living out in a village, not at the centre.

As an example of a health centre's working, Dr Kershaw describes the work done at Limuru, in the Central Province. The area served by this centre covers 80 square miles and has a population of 20 000 to 25 000. General out-patient clinics are held daily by the hospital assistant, the monthly attendance being 1800. Every week there is one child-welfare session (attendance 40-60) and one antenatal session (attendance 30-40). In addition, there are special clinic sessions for venereal diseases and leprosy. Asthma and orthopaedic clinics of a simple kind have been started, so as to inculcate in the minds of the people the idea that the chronically ill and the crippled need and deserve regular supervision.

On four days every week, the team goes out to visit towns, markets, and schools. In the town, it occupies any convenient building; in the market, it may establish itself in the open air. As the team works to a timetable, the hour of its arrival is known in advance, and when it arrives it is joined by the village chairman or headman and the health assistant responsible for the village, with whom the health problems of the village are discussed. Then the team gives a health talk to the people and holds clinic sessions—general, antenatal, and child welfare. The health visitor visits the homes of families about whom she is concerned, the health assistant checks houses and shops as required. Finally, the team holds another meeting with the town chairman or headman to discuss the problems that have arisen in the clinic sessions and the action that should or can be taken.

Schools are also visited in this area about once a month (which is more than can be accomplished in more scattered areas). In the schools health talks are given, and the children undergo a quick examination for cleanliness and overt signs of illness. The health assistant inspects the school buildings, the water supply, and the latrines.

The midwife attached to the centre does domiciliary midwifery, carrying out up to 100 deliveries a year. After the delivery, she visits the mother and baby daily for five days. Then the assistant health visitor takes over.

The health centre has other functions as well. It is the outpost of the hospital service; the hospital patient with a chronic disease is kept under surveillance, and the physician can hold periodical follow-up sessions, see long-term patients, and discuss their care with the staff of the centre. If an epidemic breaks out, the staff are admirably placed to deal with it, for they know the area intimately. If a programme of immunization is planned, they are the trusted friends of the villagers and the likeliest people to get it accepted. They can introduce eradication personnel to the villagers and see that the public co-operates. They associate themselves with all community development activities. Indeed, as Dr Kershaw remarks:

> " The potentialities of a health centre service of this kind are obvious and enormous. All the staff are in daily contact over both preventive and curative work. If a patient with an apparently infectious condition is seen as an out-patient, the health inspector or health assistant knows at once and can visit the home and take action. When the midwife or health assistant finds illness in any member of the family during a visit to the home, the sick person can

be persuaded to visit the out-patient clinic or even to go to hospital. Group teaching in personal and community hygiene can be supplemented by individual instruction on how to prevent a recurrence of the illness which has brought the patient to the centre."

The health centre at Limuru represents health centres at their best; others do not attain the high standard it sets. Among the difficulties that may prevent a centre from working well is the frequent one of insufficient staff. There may also be a lack of co-operation in the team, an absence of team spirit. Or direction and guidance may fall short of what is required; the medical officer of health may not have the time to see that the centre is working as well as it could, or he may not be very interested. It is proposed, with WHO assistance, to develop the Limuru health centre as a team training centre; this should help to provide trained staff and, by concentrating on the importance of working as a team, infuse the team spirit into the trainees.

Mobile units

Kenya has several nomadic tribes, which move with their herds of cattle from grazing-ground to grazing-ground, often over great distances. For these tribes a health centre would be of little use, as their movements are often not predictable, so mobile units have been experimented with for some years. The mobile unit is in essence a travelling health centre, with a complete team consisting of hospital assistant, assistant health inspector or health assistant, midwife, assistant health visitor, and possibly a female dresser. It carries a basic stock of drugs and instruments and tents for the staff, and visits places regularly, staying in each for two or three days. So far adequate contact has been maintained between the units and the populations involved.

On the curative side, the mobile unit may deal with more patients than the district hospital. It is particularly effective in securing a fairly high treatment rate for gonorrhoea, trachoma and other eye diseases, anthrax, and some parasitic infestations, conditions for which the tribesmen would not usually think it worth while to make the long trip to hospital. On the preventive side, the results have been less good. It must be remembered, however, that the mobile units are new, and the tribesmen among whom they work little exposed to modern education or the influences of the modern world. With time it may be possible to extend the preventive side.

The idea of training "health scouts" from the tribes has been broached. Their function would be to act as an intelligence service for the mobile units, asking for urgent medical aid when it seemed necessary, trying to spread simple ideas about prevention, and even possibly treating simple disease conditions.

SANITARY STAFF AND THEIR TRAINING *

In the nineteenth century, unprecedented industrial expansion and continual progress in the control of communicable diseases through preventive medicine led to the parallel development and application of the fundamental engineering sciences. As Dr Petrik states in the WHO monograph *The Training of Sanitary Engineers*: "The steadily growing multiplicity and diversity of problems imply application of an increasing number of sciences, beginning with mathematics and mechanics and adding successively various branches of physics, chemistry, biology and other sciences." [1]

Wider knowledge of these branches enabled the engineer to give the doctor greater understanding and support in his public health work. As a result, what was ulti-

* Extracts from a paper read at the XLth Congress of Hygiene of the Société de Médecine publique et de Génie sanitaire (held in Paris in October 1960) by Mr J. N. Lanoix, Chief, Rural Sanitation, Division of Environmental Sanitation, World Health Organization, Geneva.

[1] Petrik, M. (1958) *The training of sanitary engineers*, Geneva, p. 9 (*World Health Organization: Monograph Series*, No. 32).

mately known as sanitary engineering came into being as one of the growing number of special branches of civil engineering. According to the most commonly accepted definition, " ' sanitary engineering ' includes the public health aspects of all environmental conditions and situations, the control of which is based upon engineering principles and the application of scientific knowledge ":[2]

In the USA, two terms are currently used to designate a person specializing in this branch of study : " sanitary engineer " and " public health engineer ". In the United Kingdom, the adjective " sanitary ", as applied to the sanitary engineer or inspector or other sanitation workers, has to some extent been associated in the public mind with plumbing and sewage disposal, therefore the more modern term " public health engineer " has been given preference. Thus since 1955, by government order, the terms " public health engineer " and " public health inspector " have officially replaced " sanitary engineer " and " sanitary inspector ", although the latter term has been used for a very long time not only in the mother country but in all the British overseas territories. According to the definition adopted by the American Public Health Association, the term " sanitary engineer " refers to an " engineer who is trained in techniques that permit him to advise upon, administer, supervise, or otherwise conduct professional and scientific work where the use of engineering knowledge and skills are essential for identification and control of environmental factors that may produce a detrimental effect on the physical, mental, or social well-being of man ".[2]

The sanitary engineer

Sanitary engineering as a profession originated in the USA, making its first appearance towards the end of the last century when the campaign against contagious diseases was getting under way. In a paper presented in 1950 at the Second Inter-American Congress of Sanitary Engineering, Professor H. G. Baity recalled the suggestions made by Shattuck in his report of 1850 on the health situation in the state of Massachusetts, notably that a Board of Health should be set up in Massachusetts consisting of two doctors, a lawyer, a chemist, a civil engineer and two persons belonging to other professions. These suggestions were adopted in 1869 and an engineer was attached to the Board of Health five years later. In 1886 a sanitary engineering division was established as part of the state health department. This marked the official beginnings of sanitary engineering in the USA.

The development of sanitary engineering

Sanitary engineering played a considerable role in campaigns against gastro-intestinal diseases such as typhoid fever, cholera and the various forms of dysentery and diarrhoea. Its most spectacular successes were recorded in this initial phase, when the main object was " keeping human excreta out of the diet ". Between 1900 and the present day mortality from the diseases mentioned has been reduced by 90% in the USA. In the Chicago area in 1851-60, the mortality rate from cholera was 328.9 per 100 000, but the disease disappeared rapidly once sanitation measures had been instituted. The mortality from typhoid fever in 1900 was 35.8 per 100 000 inhabitants; fifty years later it had fallen to 0.2. Whereas in 1900 it was estimated that only 75% of the American population would reach the age of 25 and that 50% would die before the age of 57, in 1950 it was envisaged that 95% of the population would live to be over 25, while 50% would live beyond the age of 70. At the present time, infantile mortality in the USA is mainly due to prenatal causes and perinatal accidents. These few figures give some idea of what can be achieved by the improvement of environmental conditions through the systematic use of sanitary engineering techniques. Similar results were obtained by health authorities in Europe, using outside assistance from civil engineers specializing in such aspects of sanitary

[2] The American Public Health Association (1955) *Educational qualifications of sanitary engineers engaged in the field of public health*, New York, p. 1.

engineering as the purification of drinking-water and the disposal and treatment of human excreta. The main methods used were as follows:

1. The provision of drinking-water for urban populations through a water supply system serving every dwelling.

2. Sewage disposal.

3. Hygienic supervision of food at all stages of production, storage, handling and distribution.

4. Hygienic control of milk.

5. The maintenance of cleanliness in cities and villages by means of the regular collection and disposal of household refuse.

At the same time, sanitary engineers and sanitarians, together with their colleagues in the public health services, began to tackle the problems of diseases transmitted by higher species of pathogenic agents, such as malaria, louse-borne typhus and plague. An excellent example of this is provided by the malaria control campaigns carried out in numerous countries of the world, before the discovery of residual insecticides, by means of drainage and controlled changes in the level of water in reservoirs and canals.

In the second phase in the development of sanitary engineering, which somewhat overlapped the first, special attention was paid to the methods and techniques of purifying and especially of disinfecting water supplies, and to the treatment of waste water and the composting of household refuse. In these domains sanitary engineers, together with chemists and geologists, played an outstanding part. They designed and continually improved purification plants and chemical and biological procedures in such a way as to increase chemical and bacteriological efficiency and reduce unit costs. Thus in the purification of waste water, both domestic and industrial, and in the composting of town refuse, more and more was done to recover organic materials of value, particularly for use in agriculture.

It was during this second phase also that an enormous expansion took place in the food industry, with a corresponding increase in the risk of contamination of manufactured foods and spread of disease. Inspection and control procedures for all stages of production from the farm to the factory and the consumer were devised by sanitary engineers and inspectors employed by the health authorities and by the food industry itself.

At the same time, the sanitary engineering authorities in the public health departments were put in charge of sanitary inspection of housing conditions in the widest sense. This aspect of sanitary engineering is still a main preoccupation of these authorities.

The third phase is that in which we are now living. It began after the Second World War and its scope continues to widen, for the post-war development of industry in general and of atomic energy in particular has raised vast health problems, most of which have not yet been solved, even in the most advanced countries.

The dawn of the atomic era means for the sanitary engineer yet another set of units, formulas and equations. The development and use of nuclear energy for power and other purposes exposes the public to radiation and radioactive contamination.

Research into the health problems raised by air pollution is only a recent development. The progress made can be compared with that made in the control of water pollution by 1925. The problems are similar but are technically much more difficult to solve.

This rather brief survey shows that in all countries sanitary engineering (or environmental sanitation) programmes go through various stages corresponding approximately to the various stages in the development of the countries concerned. Most of the countries in the less developed regions of the world are at the stage of communicable-disease control. In regions with a more developed and still expanding economy sanitary installations are being introduced at an increasing rate; research is being intensified in order to find more effective and economical procedures, and more attention is being paid to social factors.

The WHO Expert Committee on Environmental Sanitation has stated, however, that in all areas and among all peoples

"sanitation is fundamental and basic to individual and community existence. It relates to the essentials of life and health, the environmental significance of air, water, food, and shelter, which last includes clothing, and, in some places, protection against insect vectors of disease. These basic environmental essentials are common to all peoples, and the differences between areas are not differences in kind but only in complexity."[3]

Present scope of sanitary engineering

As has been seen, the scope of sanitary engineering has widened during the last sixty years as new health problems have been raised by the development of industry and the progress of preventive medicine. Today, it comprises the following activities:

1. Water supply: treatment and distribution.

2. Sewerage systems; treatment of waste water and industrial waste and control of treatment procedures. Sewage disposal in the countryside and suburbs.

3. Measures against water pollution.

4. Removal and disposal of household refuse in towns and rural areas.

5. Action against rodents and insects and against harmful plants.

6. Ensuring the safety of foodstuffs: this includes the production, pasteurization and treatment of liquid milk and of manufactured dairy products, control of the treatment, storage, handling and distribution of meat and meat products, poultry, bakery products, fish, shellfish, and preserved or frozen foods, and the ensuring of hygienic conditions in restaurants and places where drinks are served.

7. Ensuring hygienic conditions in schools, public meeting-places, camps, summer resorts, bathing pools, beaches, and places of amusement.

8. Measures to encourage the building of hygienic dwellings.

9. The prevention of accidents in the home.

10. Action against pollution of the atmosphere by smoke and fumes, dust, gas, odours and pollen.

11. Industrial hygiene and sanitation, which confront the engineer with special problems related to industrial operations and manufacturing processes and involving various aspects of environmental sanitation.

12. Town planning and redevelopment, particularly from the standpoint of housing standards, heating, lighting, ventilation and sewerage.

13. Measures against noise.

14. The health aspects of measures of protection against ionizing radiation.

Duties of sanitary engineers

The duties of sanitary engineers vary somewhat according to whether they are employed by the public health authorities or by public works departments, in industry, in the offices of consultant engineers, or in the teaching of sanitary engineering. In general, however, the sanitary engineer is mainly concerned with the design and specifications, construction, operation and management of sanitary installations for the preservation of public health.

According to Professor Baity,[4] groups of experts, eminent educationalists, and professional bodies that have studied the place and function of the sanitary engineer in public health seem to agree on the following principles:

1. Sanitary engineering and medicine are parallel professions with functions that are mutually complementary but not interchangeable. Traditionally, the physician usually occupies a position of general administrative responsibility.

2. For maximum efficiency and rational organization, a sanitary engineer should be placed in an administrative position with the authority to plan, organize and direct all

[3] *Wld Hlth Org. techn. Rep. Ser.*, 1957, 77, 4.

[4] H. G. Baity (1951) *The sanitary engineer : his training and opportunity* (unpublished working document WHO/Env.San./15).

engineering and environmental sanitation programmes. He is usually and logically the second in rank in the agency.

3. The status of the sanitary engineer in the organization and his scale of remuneration should be the same as those of physicians in charge of services at the same level.

4. Where local health jurisdictions are too small to afford a capable engineer, the necessary help and advice should be provided from a higher level.

5. Sanitary engineering functions and responsibilities should be integrated through all levels of administration from central down to provincial and local. Medical or other personnel should have no concern with these functions except in purely administrative matters.

6. Competent and qualified sanitarians are valuable members of the health department.

7. A third group of sanitation personnel, known under such titles as sanitary inspectors, sanitation aides, sanitary officers etc., is a continuing necessity in local health departments. These persons are of sub-professional grade and qualified to carry out specific duties under supervision. They are not eligible to advance to the position of sanitarian or sanitary engineer except as they may qualify by conforming to educational and experience requirements.

The sanitary engineer in WHO

The work of WHO in environmental sanitation is based on the fundamental principle that the first essential is to strengthen the governmental authorities whose specific task it is to undertake, encourage and maintain sanitation by direct or indirect participation and influence. To achieve this end a general programme has been drawn up according to which the main tasks of WHO are as follows:

1. The giving of technical guidance on all aspects of environmental sanitation services.

2. The inauguration and encouragement of work on environmental sanitation in various countries through the Regional Offices, with the primary aim at the present stage of establishing administrative services, improving urban and rural hygiene, training sanitation workers and disseminating information.

3. The giving of advice and guidance on such matters as vector control, joint research on insect resistance to insecticides, quality standards for water, food hygiene, atmospheric pollution, and the choice of products and equipment.

4. Work in co-operation with the United Nations, the specialized agencies, non-governmental organizations, and professional bodies on such matters as water supply, the use of pesticides and the study of their toxicity, the hygienic aspects of air transport and the influence of sanitation on social problems such as housing, urban development and the reclamation of arid lands.

At the present time, WHO employs 48 sanitary engineers in 33 countries, working as consultants to ministries of public health, members of public health teams, specialists on the control or eradication of communicable diseases, teachers of sanitary engineering, or short-term consultants on particular problems such as supplying towns with water.

Training of sanitary engineers

Since sanitary engineers, in whatever capacity they may be employed, contribute to the public health work conducted and directed by governmental health services, there is an obvious advantage in their being trained in the same universities as public health physicians. In several American universities joint courses have been arranged to offer these two groups the opportunity of meeting and understanding each other and learning to work together.

Basic training in civil engineering is considered to be the best foundation for sanitary engineering, but it is not the only one. Engineers who have obtained degrees in mechanical engineering, electricity, rural engineering or architecture can also work for a higher degree in sanitary engineering.

They will naturally be inclined to approach the subject from the angle of their own particular specialties. Engineers with degrees in chemistry or biologists can also become public health engineers after an additional year of public health studies. In certain spheres, such as ventilation and air-conditioning, accident prevention and the protection of the public against ionizing radiation, there are specialists whose particular knowledge of physics and technology has very little connexion with the basic sciences of sanitary engineering and whose training in biology includes very little bacteriology. In ventilation and air-conditioning, for example, the basic subjects are physiology and psychology. To deal with certain important problems of industrial hygiene, a knowledge of human biochemistry, toxicology and pathology is required. Similarly, a knowledge of meteorology, physics, heating and applied chemistry is necessary for the control of air pollution. These spheres of activity, although apparently distinct, are all part of sanitary engineering, since they all have the same object: the protection and promotion of public health through the use of the principles of civil engineering. They form, however, definite areas of specialization within the wider subject of sanitary engineering.

As indicated above, the best method of training sanitary engineers is to give graduate engineers an extra year of special studies including theoretical courses, laboratory work, the design of civil engineering structrues, the inspection of engineering sites, and field work. For various reasons other methods are or have been used in some countries. Thus in the USA a university course in sanitary engineering, covering four years like the undergraduate course in civil engineering, has been tried out. Elsewhere short courses and part-time teaching are used.

Short courses lasting from two to six weeks or thereabouts are useful, particularly in the form of refresher courses limited to one particular aspect of sanitary engineering. Such courses can be on a very high academic level, and the teaching can be extremely thorough, since the engineers attending them will already have practical experience of the subjects studied. They can be extremely useful for training staff entrusted with the organization, functioning and financing of drinking-water supply systems.[5]

In many countries there is a great lack of staff capable of organizing, implementing or supervising environmental sanitation programmes, both at the national and at the provincial or municipal levels. It is therefore necessary to strengthen or even to establish facilities for technical training in these countries. WHO started on this task as long ago as 1948 and is already reaping the benefit of its efforts in all parts of the world.

Advanced training courses for civil and municipal engineers have been arranged by the Organization in several countries, including the Netherlands, Belgium, Sweden and Portugal. Other courses, on the operation of water-treatment installations, have also been given on a regional level and have been attended by engineers and technicians from several countries, e.g., the courses held in 1953 in New Delhi for persons from India, Burma, Ceylon and Indonesia, and at Alexandria for engineers from the United Arab Republic, Ethiopia, Iraq, Iran, Jordan, Lebanon, Pakistan, Saudi Arabia, Somaliland and Tunisia. In the Americas similar courses have been held in Honduras, Guatemala, Mexico, Uruguay, Trinidad and Cuba for these and neighbouring countries.

WHO has encouraged the establishment of permanent training institutions for sanitary engineers and sanitarians in Brazil, Mexico and Chile since 1952. By providing teaching staff, the Organization has also helped to establish sanitary engineering and public health departments at the University of Madras in India and Alexandria University in Egypt. Teachers have also been sent to the Haifa Technion in Israel, the University of the Philippines, the University of Thailand and the American University at Beirut in the Lebanon. In connexion with the sanitary engineering programme inau-

[5] Wagner, E. G. & Lanoix, J. N. (1959) *Water supply for rural areas and small communities*, Geneva (*World Health Organization: Monograph Series*, No. 42).

gurated by the University of Naples in 1955, special study fellowships have been awarded to Italian engineers. WHO has also sponsored a European symposium on the training of sanitary engineers and a census of all the institutions in Europe and the USA that specialize in this subject.

Numerous meetings on various aspects of sanitary engineering and administration, a complete list of which would be too long to give here, have also been held by WHO in various countries. Particular mention should be made of the meeting in Tokyo in October 1959, which was perhaps partly responsible for the recent establishment of a department of sanitary engineering and of special courses in the subject at three large Japanese universities.

The sanitary inspector

The sanitary engineer did not appear on the scene until the beginning of the twentieth century. The " sanitary inspector ", as he is still called in the USA, is better known; in fact, there have been sanitary inspectors for several centuries. In ancient Rome, a number of inspectors were employed to supervise the quality of drinking water. In 1350, the King of France established a " sanitary police force " which was the first service of its kind in Europe. Its duties were to prevent pigs from entering cities, to keep the streets clean, and to prohibit the sale of rotten meat and fish. Not so long ago, the sanitary inspector still acted as a policeman, ensuring respect for the laws, regulations and ordinances relating to public health.

Sanitary inspection developed rapidly in the nineteenth century, particularly in the English-speaking countries, to such an extent that in several countries today sanitary inspectors, like doctors, engineers or public health nurses, have professional status. In the United Kingdom and the countries under its cultural influence they are now called " public health inspectors ", while in the USA the term " sanitary inspector " still persists, but those with university training tend to be known as " sanitarians ". In the health administration, the sanitarian supervises the work of the sanitary inspector, whose theoretical training is less extensive than his own. A sanitary inspector may of course at any time undertake further study and qualify as a sanitarian. In this paper, the various categories of sanitation staff will be grouped together under the general title of " sanitary inspector ", a distinction being made between them only where necessary.

Duties of the sanitary inspector

Long before the sanitary engineer arrived on the scene the sanitary inspector played a leading part, as the assistant of the physician and later of the engineer, in the development of sanitation activities in all countries. A WHO Expert Committee on Environmental Sanitation has called the sanitary inspector " the backbone of the sanitation service ".[6] His main task is to supervise the implementation of laws and regulations on public health, and his activities fall within the scope of environmental sanitation as described earlier. In particular, he has to carry out sanitary investigations and educate the public in matters of public health. His investigations may be undertaken as part of a campaign against contagious diseases, such as typhoid and paratyphoid fevers, the various forms of dysentery, cholera, etc. As the assistant of the public health officer in epidemiological surveys, the sanitary inspector takes samples of water, examines the condition of the piping through which drinking-water passes, and of sewerage and household refuse disposal systems, investigates the procedures used for the treatment and disinfection of drinking water, the production, handling and pasteurization of milk, the production, transport and hygienic sale of foodstuffs, health conditions in houses, etc. In the campaign against other communicable diseases, his investigations will extend to insect disease vectors and the rodents that carry them, and to conditions of hygiene in hotels, motels, restaurants, schools, holiday

[6] *Wld Hlth Org. techn. Rep. Ser.*, 1952, 47, 11.

camps and children's holiday homes, swimming pools and public baths. The sanitary inspector must also be capable of interpreting health regulations and contributing to any changes in laws and other regulations that may be considered necessary. He assists any group of citizens seeking to improve health conditions in the community, and must be capable of giving talks to them and providing them with any technical information that may help to guide and inform public opinion. He gives lectures and demonstrates health procedures in schools or other public places. Within the sanitation services he also acts as the administrative supervisor of officials and employees of a lower grade than his own.

In the less developed countries where there is a shortage of public health physicians and sanitary engineers, the whole responsibility for the administration of the sanitation services often falls on the shoulders of the sanitary inspectors. Not having the advantage of technical supervision and advice, they must be capable of taking the necessary administrative or practical decisions on their own initiative. In such countries the quality of the training of sanitary inspectors is of primary importance.

In the rural areas, the role of the sanitary inspector is even more important since he must not only help the district medical officer but must also implement and direct in person programmes of rural sanitation in which, in many cases, no other branch of the administration takes an interest. This applies particularly to programmes for the building of latrines and small water-supply systems. The important thing in such cases is to work out simple and economical sanitary methods that will make practical achievements possible, due allowance being made for topographical, geological and other conditions in the area. Normally, the sanitary inspector faced with problems of this kind ought to be able to call upon the sanitary engineer in his department. In France, the rural engineer, through his special training, often assists small communities in solving certain sanitation problems. However, in countries or regions where there are no rural engineers the sanitary inspector must possess the necessary mental equipment and training to undertake this type of work on his own initiative.

One of the most important functions of any sanitary inspector is to educate the public and guide its activities. "Almost every branch of environmental sanitation has its health education aspect, and various sanitation personnel have excellent opportunities for practical educational work on sanitation problems", said a WHO Expert Committee [7] recently, and added, "They visit people in their homes, meet food-handlers at their place of work, and are in constant and close touch with many groups in the community whose activities have a special public health significance: for example, people engaged in certain trades such as the production, preparation and distribution of food and drinking-water, employees of industrial undertakings, and workers exposed to special occupational risks... Sanitation workers have unrivalled opportunities of carrying out effective health education by demonstrating on the spot how the principles and practices of environmental sanitation should be observed, and pointing out faulty habits or practices as they occur." Experience has also shown that the public needs to be educated to accept health legislation and that health legislation can be effective only if it is firmly based on an informed public opinion. This does not mean that sanitation workers should be specialists in health education. Nevertheless, it is their duty to contribute to this useful task, on the same footing as the public health officer and the district nurse, under the guidance of the health education specialist.

Health inspectors are constantly in close touch with the public, and must have the personal qualities that will make their actions and influence effective. They no longer act as policemen, compelling the population to comply with health legislation, but rather as advisers. They must therefore be able to convince by persuasion and to gain the confidence of the public by their

[7] *Wld Hlth Org. techn. Rep. Ser.*, 1958, **156**, 14.

behaviour and tact and their ability to give soundly based practical advice unhesitatingly. As members of health teams, they must be able to maintain excellent professional relations with their colleagues (doctors, district nurses, etc.), and to show initiative, tact, judgement, integrity and a sense of civic duty.

Training of sanitary inspectors

The curricula for the training of sanitary inspectors in different countries are extremely varied and sometimes oddly assorted. Even in big countries like India or the USA there are appreciable differences between the curricula of the various establishments for training sanitary inspectors. During the last ten years, great efforts have been made in the USA to harmonize and regulate these curricula. The tendency in that country, where technological advances are creating health problems of ever increasing complexity, is to raise the educational level required and to employ in the public health services, particularly in leading posts, sanitary inspectors with at least a B.Sc. degree in sanitary science obtained after four years of university study. In India, at a conference recently held under WHO auspices, the directors of the educational establishments concerned discussed the principles on which to base curricula for sanitation training in that country. Teachers have been sent by WHO to a number of countries and territories at their express request to reorganize or help to inaugurate the teaching of sanitation. These countries and territories include Brazil, Ceylon, Chile, China (Taiwan), India, Liberia, Libya, Morocco, Nepal, Nigeria, Panama, Paraguay, the Philippines, the Seychelles, Somaliland, Turkey, the United Arab Republic, Viet-Nam, and Zanzibar.

In some regions, the health assistant is trained for medical as well as sanitation work. For example, he is taught how to use vaccines and detect certain tropical diseases. In most countries, however, the sanitary inspector is trained solely to carry out sanitation work and not paramedical clinical work. Indeed, experience seems to have shown that the so-called multipurpose workers invariably end up in village or jungle clinics and after a few months cease to act as sanitation workers. In such cases sanitation becomes completely neglected, with all the consequences that this entails.

The duration of courses for sanitary inspectors varies from one country to another. In the USA four years of university study are required for sanitarians. In most countries sanitary inspectors must study for two to three years after matriculating or after their secondary education, while sanitation aides or assistant sanitary inspectors are given courses of six months to two years. In the United Kingdom, the General Certificate of Education is compulsory, and training lasts four years; there is an average of only 6½ teaching hours per week, making a total of 910 hours of theoretical study, but the student works as a probationer in the sanitation services throughout his four years of training. The principal factor to be taken into consideration is the educational level of the students. Thus in certain countries young people must be recruited who have had only nine or ten years of schooling and whose ordinary education and training in the humanities must be completed at the sanitation school. Practical suggestions in this connexion have been made by Wagner and Lanoix in a WHO Monograph.[8]

[8] Wagner, E. G. & Lanoix, J. N. (1959) *Water supply for rural areas and small communities*, Geneva (*World Health Organization : Monograph Series*, No. 42).

TRENDS IN DENTAL EDUCATION

The adequacy of present dental care and the problems implicit in anticipating, and planning to meet, future needs in that field have been studied in many individual countries in recent years. Now, for the first time, WHO has made available a compilation of the basic data, in its *World Directory of Dental Schools*,[1] just published in a format similar to that of its *World Directory of Medical Schools*.

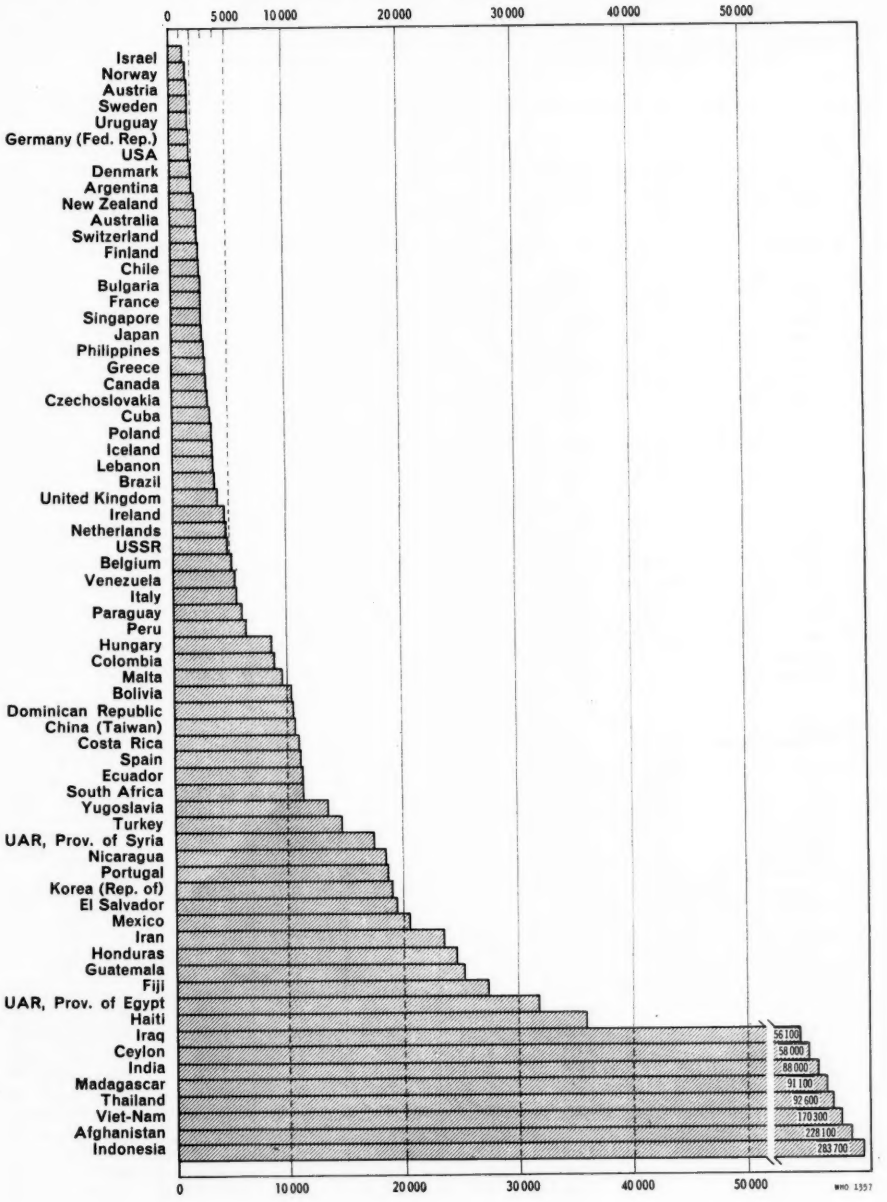
An important trend discernible from this directory is the increasing emphasis on public health dentistry and preventive dentistry in dental education. Of the 70 countries listed in the Directory, 21 report public health courses in their dental schools and 21 report courses in preventive dentistry. Only 8 countries appear in both lists. Not included in these figures are courses whose content may well overlap with public health or preventive dentistry, such as " epidemiology and statistics ", " social hygiene ", and the like. It is interesting to note that only 8 of the 21 nations reporting public health courses, and only 4 of those reporting preventive dentistry courses, are European, reflecting perhaps a less urgent need in the European nations because of a more favourable ratio of professional dental personnel to population—or perhaps merely a more conservative and a more traditional approach to dental training.

The ratio of registered dentists to population, given in the Directory for each country and shown in the graph on page 339, serves a useful purpose as a crude quantitative measure of the adequacy of dental care and as a starting point for the public health administrator attempting to determine the optimum ratio for his country. Many factors will affect this determination. Among them are the extent to which available personnel are used in the various forms of what has been broadly termed " social dentistry "; the degree of utilization of dental auxiliary personnel; and the quantity and quality of dental research and its application to the prevention of dental disease. It is precisely because public health dentistry has a large part to play in each of these areas that recognition of its importance in dental schools is growing. The Directory offers no data on dental auxiliary personnel or on dental research; but it is hoped that such data may eventually become available and be incorporated in later editions.

It would be rash indeed to attempt to draw conclusions from, or base predictions on, the admittedly incomplete material made available in the Directory. Terminology is still unstandardized: even a cursory inspection reveals that there is little common ground (other than the function they perform) between the " secondary " or " assistant " dental practitioners, or the unregistered and presumably unqualified ones, still found in some countries, and the physician-dentists of other countries. Methods of collecting data are far from comparable: even the number of qualified dental practitioners given for some countries represents only an estimate, because of varying registration requirements. In countries that have no provision for separate registration of physicians who may practise dentistry as a specialty, the figures include as dentists only those so registered or those who belong to a professional dental association, and will therefore be too low. Moreover, the tabulation gives no indication of the number engaged in actual treatment of patients, as against those who have retired from active practice or who are engaged in administrative work, research, or teaching. Such a breakdown of the statistics is not yet available; but clearly, the more advanced a nation's dental public health programme, the more extensive its training facilities, and the higher the standards of its dental schools, the more numerous will be these " exemptions " from the statistics on registered dentists.

[1] World Health Organization (1961) *World Directory of Dental Schools*, Geneva.

POPULATION PER REGISTERED DENTIST



NUMBERS OF DENTAL SCHOOLS, REGISTERED DENTISTS, AND DENTISTS GRADUATED, 1958 *

	Population (in thousands)	Dental schools	Registered dentists	Dentists graduated	Population per registered dentist	Dentists graduated per 1000 registered dentists	Population per dentist graduated (in thousands)
Africa							
Madagascar	4 644 [a]	1	51 [a]	—	91 100 [a]	—	—
South Africa	14 418	2	1 288	51	11 200	39.6	283
Americas							
Argentina	20 248	4	9 890	480	2 000	48.5	42
Bolivia	3 369	3	328	29	10 300	88.4	116
Brazil	57 098 [a]	36 [a]	15 532 [a]	—	3 700 [a]	—	—
Canada	17 048	6	5 564	203	3 100	36.5	84
Chile	7 298	3	2 800 [g]	104	2 600	37.1	70
Colombia	13 227 [d]	4 [d]	1 500 [d]	147	8 800 [d]	...	92
Costa Rica	1 076	1	99	9	10 900	90.9	120
Cuba	6 666 [e]	1 [e]	2 000 [e]	55 [e]	3 300 [e]	27.5 [e]	121 [e]
Dominican Republic	2 797	1	270	20	10 400	74.1	140
Ecuador	3 929 [d]	3 [d]	351 [d]	—	11 200 [d]	—	—
El Salvador	2 434	1	127	12	19 200	94.5	203
Guatemala	3 546	1	141	6	25 100	42.6	591
Haiti	3 384 [d]	1 [d]	95 [d]	3 [d]	35 600 [d]	31.6 [d]	1 128 [d]
Honduras	1 828	1	75	7	24 400	93.3	261
Mexico	30 538 [c]	10 [c]	1 501 [c]	—	20 300 [c]	—	—
Nicaragua	1 333 [d]	1 [d]	73 [d]	—	18 300 [d]	—	—
Paraguay	1 638 [d]	1 [d]	271 [d]	—	6 000 [d]	—	—
Peru	10 069 [e]	1 [e]	1 600 [e]	90 [e]	6 300 [e]	56.3 [e]	112 [e]
USA	173 232	46	101 623	3 083	1 700	30.3	56
Uruguay	2 679 [d]	1 [d]	1 650 [d]	43 [d]	1 600 [d]	26.1 [d]	62 [d]
Venezuela	6 037	3	1 140	137	5 300	120.2	44
Eastern Mediterranean							
Iran [f]	19 677	1	842 [g]	39 [e]	23 400	...	...
Iraq	6 952 [e]	1 [e]	124 [e]	20 [e]	56 100 [e]	161.3 [e]	348 [e]
Israel	1 937 [d]	1 [d]	1 387 [d]	12 [e]	1 400 [d]	...	172 [e]
Lebanon	1 525 [d]	1 [d]	420 [d]	12 [d]	3 600 [d]	28.6 [d]	127 [d]
Pakistan	85 635	1	—	16	—	—	5 352
United Arab Republic							
Province of Egypt [f]	24 791	2	785	71 [e]	31 600	...	357 [e]
Province of Syria	4 032 [d]	1 [d]	233 [d]	23 [d]	17 300 [d]	98.7 [d]	175 [d]
Europe							
Austria	7 022	3	4 321	52	1 600	12.0	135
Belgium	9 053	4	1 778	69	5 100	38.8	131
Bulgaria	7 728	1	2 856	150	2 700	52.5	52
Czechoslovakia	13 474	8	4 162	138	3 200	33.2	98
Denmark	4 515	2	2 346	100	1 900	42.6	45
Finland	4 376	1	1 778	60	2 500	33.7	73
France	44 091 [d]	17 [d]	16 592 [d]	—	2 700 [d]	—	—
Germany:							
Federal Republic [i]	53 710 [d]	17 [d]	32 055 [d]	—	1 700 [d]	—	—
Greece	8 173	1	2 692	120	3 000	44.6	68
Hungary	9 856 [d]	1 [d]	1 137 [d]	31 [d]	8 700 [d]	27.3 [d]	318 [d]

DENTAL SCHOOLS, REGISTERED DENTISTS, AND DENTISTS GRADUATED, 1958 *(concl.)*

	Population (in thousands)	Dental schools	Registered dentists	Dentists graduated	Population per registered dentist	Dentists graduated per 1000 registered dentists	Population per dentist graduated (in thousands)
Europe *(cont.)*							
Iceland	158 [b]	1 [b]	44 [b]	1 [b]	3 600 [b]	22.7 [b]	158 [b]
Ireland	2 885 [d]	4 [d]	625 [d]	50 [d]	4 600 [d]	80.0 [d]	58 [d]
Italy	48 279 [c]	12 [d]	8 700 [c]	—	5 500 [c]	—	—
Malta	322	1	34	5	9 500	147.1	64
Netherlands	11 026 [d]	2 [d]	2 350 [d]	104 [d]	4 700 [d]	44.3 [d]	106 [d]
Norway	3 556 [e]	1 [e]	2 390 [e]	130 [e]	1 500 [e]	54.4 [e]	27 [e]
Poland	28 783	8	8 380	561	3 400	66.9	51
Portugal	8 909 [d]	0	485 [d]	—	18 400 [d]	—	—
Romania	17 829 [d]	2 [d]	—	130 [d]	—	—	137 [d]
Spain	29 662	1	2 700	111	11 000	41.1	267
Sweden	7 367 [d]	2 [d]	4 600 [d]	220 [d]	1 600 [d]	47.8 [d]	33 [d]
Switzerland	5 185	4	2 154	69	2 400	32.0	75
Turkey [f]	26 000	1	1 765	80	14 700	45.3	325
USSR	208 827 [d]	78 [d]	43 659 [d]	—	4 800 [d]	—	—
United Kingdom	51 680	16	13 230 [h]	518	3 900	39.2	100
Yugoslavia	17 791 [c]	4 [c]	1 323 [c,g]	—	13 400 [c]	—	—
South-East Asia							
Afghanistan	13 000	1	57	6	228 000	105.3	2 200
Ceylon	9 388	1	162	12	58 000	74.1	782
India [j]	340 000 [k]	7	6 881 [k]	100	50 900 [k]	14.5 [k]	3 400 [k]
Indonesia	85 100 [d]	2 [d]	300 [d]	55 [d]	284 000 [d]	183.3 [d]	1 500 [d]
Thailand	21 474	1	232	18 [e]	92 600	77.6	1 193 [k]
Western Pacific							
Australia	9 846	5	4 142	97	2 400	23.4	102
China (Taiwan)	9 851	2	939	20	10 500	21.3	493
Fiji	352	1	13	3	27 100	230.8	117
Japan	92 007	7	32 484	822	2 800	25.3	112
Korea, Republic of	22 505	1	1 190	100	18 900	84.0	225
New Zealand	2 286	1	1 057	40	2 200	37.8	57
Philippines	23 122	10	7 919	369	2 900	46.6	63
Singapore	1 515	1	569	15	2 700	26.4	102
Viet Nam, Republic of	12 600 [d]	1 [d]	74 [d]	2 [d]	170 000 [d]	27.0 [d]	6 300 [d]

* Unless otherwise specified.
— Data incomplete or not available.
... Ratio not computed because available data are for different years.
[a] 1954 data.
[b] 1955 data.
[c] 1956 data.
[d] 1957 data.
[e] 1959 data.
[f] The 1958 data given here were not available for inclusion in the text of the Directory.
[g] Does not include registered medical practitioners practising dentistry.
[h] Dentists in National Health Service only.
[i] Including West Berlin; figures for Democratic Republic not available.
[j] Excluding areas where the Dentists Act had not been enforced up to 1958.
[k] Approximate figure.

Nevertheless, the statistics gathered in the Directory, taken together with the descriptions of dental education in the various countries, afford raw material for further analysis, as well as a yardstick against which future progress can be measured in later editions. There are few surprises here; as with the data given in the WHO *World Directory of Medical Schools*, the magnitude of the disparity between the nations of South-East Asia at one extreme and those of Europe and North America at the other is vividly brought home (see table). Even in Europe and North America, it is apparent that no nation has achieved a level of dental care that is fully adequate to the need or the demand—at best one can speak only in terms of relative adequacy. Some countries that seemed to be within sight of such relative adequacy less than a generation ago find themselves losing ground today as their populations increase at a rate that outstrips their professional training facilities. Moreover, even if a nation succeeds in increasing its production of professional dental personnel in proportion to the population, the problem of distribution of the needed manpower is a knotty one in the social context of many countries.

Dental public health administrators and officials of dental schools will be especially interested in correlating the increase in their populations with the current and expected increment in their professional dental personnel, as a help in anticipating and planning to meet future needs. Analysis shows that as dental schools raise their standards and introduce more selective admission procedures, some countries may find it difficult to maintain their present favourable ratios and will probably look to the factors already mentioned—preventive dentistry, social dentistry, utilization of auxiliary personnel, and dental research—for improvement of dental care. But for many countries the problem will perhaps for some time continue to be how to expand existing institutions for professional dental training and create new ones: thus at the XIIth International Dental Congress, held in Rome in 1957, Sweden and Denmark reported twice the number of applicants that could be accepted in their dental schools, Norway three times the number, and Finland ten times. It is significant that, of the 276 dental schools in all countries for which the Directory reports the date of foundation, 91, or nearly one-third, were established within the past twenty years. Among other countries shown by the Directory to be engaged in a determined drive to increase the number, as well as the quality, of dentists is the USSR, which reports no less than 16 new dental schools founded in the past decade (12 of them within the space of two years) as against half that number in the three preceding decades combined.

Certain other trends in dental education, which have important implications for the quality of future dental care throughout the world, emerge from the descriptions of dental education in the various countries, although many more data are needed before the significance of these trends can be properly evaluated. One is the tendency for dental schools to be set up as independent faculties rather than as departments within a medical faculty. Both systems have their proponents within the dental profession, but the tide seems to be running in favour of the independent dentistry faculty (although often with some affiliation with a medical school), especially in the non-European countries, in spite of the centuries-long history of dentistry as a medical specialty. Of the countries reporting on this point in the Directory, 40 (only 7 of them European) have separate dentistry faculties, whereas only 21 (13 of them European) have dental schools that form part of a medical faculty. In 4 European and 3 non-European countries there are examples of both systems. In this connexion it may be noted that France, where the private dental schools are set up as independent faculties and the State dental schools are incorporated into medical faculties, reported at the XIIth International Dental Congress a strong current of opinion in favour of a uniform system of independent dental faculties.

Nevertheless, as standards of dental education are raised, the prospective dental surgeon everywhere spends more and more of his time on general medical education, often

sharing many of his classes with medical school students. Only two or three countries require, for the dental surgeon, the period of internship that has become almost universal for medical school graduates, and there seems to be little tendency in other parts of the world to follow the example of European nations such as Austria and Italy, which require a medical degree as a preliminary to admission to a dental school. But countries that have had shorter dental training programmes on a lower professional level, often designed to meet emergency needs, are discontinuing them. Thus the USSR is increasing enrolments in stomatological institutes and faculties for graduate physicians and decreasing enrolments in the non-graduate schools of dentistry, with the intention of eventually discontinuing the latter; and Yugoslavia, although not requiring a medical degree, has almost completely eliminated " vocational " dental schools.

Finally, one may point to a marked tendency among dental schools in recent years to absorb into the dentistry curriculum proper what was formerly termed " predental " work. More courses in the applied biological sciences are found throughout the average four-year dental curriculum, and the student begins clinical dental work earlier, so that the practical application of the basic sciences to dentistry receives more emphasis. This parallels recent trends that are found in the medical curriculum in many countries.

ANIMAL LEPTOSPIROSIS IN MALAYA

Leptospirosis attacks many animal species as well as man and there are many types of pathogenic *Leptospira* spirochaete, distinguishable in the main only by their serological characteristics. The different kinds of leptospirosis resemble one another fairly closely in epidemiology and pathogenesis, but the seriousness of any particular attack depends on the variety of the responsible organism and on the environmental background. The animals which carry and excrete *Leptospira* are both wild and domestic. The most important, in respect of both their number and their infectivity for man, are the small rodents—notably the rat and the mouse—and these are followed by the pig, the dog, the bovines, the horse, a few other mammals, and some wading birds.[1] These animal carriers often do not themselves exhibit any signs of the disease, but they excrete organisms in their urine for periods varying from a few weeks to the whole of their adult lives and so transmit infection to other animals and man.

Man himself is always a casual victim, of no importance in the life history of the *Leptospira*, and only very rarely a carrier. Domestic animals may at times function as relatively unimportant hosts. A frequent mode of infection is through water contaminated with infected urine, although infection through direct contact with diseased animals may also occur. Thus human infections are often associated with certain occupations such as agriculture and work in sewers and drainage systems, and they also occur quite commonly after falls into dirty rivers and canals.

Interest in leptospirosis in Malaya began substantially with the work of Fletcher[2] 30 years ago, and was reinforced during the Second World War owing to the frequent infection of combat troops in that theatre; it was estimated that some 41% of cases in British troops initially diagnosed as pyrexia of unknown origin were, in fact, cases of leptospirosis. Considerable importance attaches therefore to a study of the animal reservoirs of leptospiral infection in Malaya and of the methods of spread to domestic animals and man. The results of such a study, an exhaustive investigation by the Institute of Medical Research at Kuala Lumpur, have recently been published in

[1] Babudieri, B. (1961) *Bull. Wld Hlth Org.*, **24**, 45.

[2] Fletcher, W. (1928) *Trans. roy. Soc. trop. Med. Hyg.*, **21**, 265.

the WHO Bulletin.[3] Animals were trapped and collected from representative sample localities in forest and cultivated and scrub land, and from towns and villages. The sera were examined for antibodies, and cultures from the kidneys were used to grow the spirochaetes, which were classified by a micro-agglutination technique.

The main finding of this investigation, as it applies to the leptospiral zoonosis in Malaya, is that the part played by man or by domestic animals—or, indeed, by any vertebrates other than rats—is negligible and largely irrelevant to the extent of the natural reservoir of the disease. It does sometimes happen, however, that these occasional hosts carry infection to receptive rats in areas hitherto free of the disease. Rats constitute by far the commonest hosts, though many other animals are infected from time to time. Among domestic animals the highest antibody levels (28%) were found in goats, the lowest (4%) in oxen. Different rat species vary a good deal in their serum antibody and infection rates. There is a tendency for females to be infected more often than males—three times as often in the case of *Rattus sabanus*—but the Hyos strain of *Leptospira* was found only in males. Among the house-infesting rodents, although some are much more commonly infected than others, the importance of any one species as a reservoir of infection for man depends mainly on how numerous this species is and not on how commonly it is infected. Thus, although the lowest rate of infection (3%) was found in the common Malayan domestic rat (*R. rattus diardi*), this happens to be the species that is mainly responsible for human infections in towns owing to its continued close proximity to man; while the very highly infected *R. norvegicus*, which is of recent introduction and mainly confined to seaports, is of little importance in this connexion. Other house-infesting species are *R. exulans*, *Paradoxurus hermaphroditus* (the palm civet, which gets into roofs) and the shrew *Suncus murinus*. No evidence of infection was found in the house mouse. Among the rodents of scrub and cultivated land the ricefield rat (*R. argentiventer*) has an infection rate as high as 53% in some areas; yet in spite of this finding leptospirosis is not an occupational disease of agricultural workers in Malaya, for reasons not altogether clear.

During the course of the investigation practically every strain of *Leptospira* was isolated. In all, 104 were identified; about half the total infections were due to *L. javanica* or *L. icterohaemorrhagiae*, the remainder to organisms distributed among a further 11 subgroups. The survival of the organisms in any area depends on the existence in a favourable environment of a sufficient population of an infected host that can effectively excrete the spirochaetes. Such a population appears to be of the order of 5-10 rats of all species per hectare, or 2 rats of any one species, and a suitable host is one that is easily infected but remains relatively unaffected by the disease and in which organisms can multiply in the renal tubules for long periods. The efficiency of any one rat species in spreading disease can be assessed from the ratio between culture and serology rates. Infectivity is greatest when serum antibody rates and leptospiral excretion rates are both high. The antibody rate rises sharply after the second month of life and such animals probably remain continuing sources of infection throughout their lives. The rats of this high incidence group are those occurring in large populations where man-made conditions provide an artificially high food supply. Here there is intensive transmission of a single serogroup among the crowded population of a particular species, *L. icterohaemorrhagiae* by *R. norvegicus* in houses, *L. javanica* by *R. argentiventer* in ricefields. When both serology and excretion rates are intermediate, serogroups of all classes are transmitted at low intensity through urinary contamination of damp soil among a normal population of ground rats frequenting wet places. An example is the forest rat *R. mülleri* transmitting six serogroups. Finally, when antibody rates are disproportionately higher than excretion rates, infections tend to be only fleeting and

[3] Smith, C.E.G. et al. (1961) *Bull. Wld Hlth Org.*, **24**, 5, 23, 807.

transmitted at low intensity, possibly venereally, among a normal ground rat population in dry places. Here the hosts include *R. sabanus* and *R. whiteheadi* and there are a number of serogroups: Canicola, Autumnalis, Grippotyphosa, Hebdomadalis and Bataviana. Of these three main types of rat infection the first two involve contact with infected soil and so may be a source of human infection; the third is unlikely to be so.

In general, infection and infectivity are highest in rats that stay close to ground level, excreting organisms on to the surface of the soil and acquiring infection via the mucous membranes or through cuts on the limbs. It may be that leech bites sometimes play a part in transmission, and larger predators may become infected after eating diseased rats. The density of the rat population and the presence of local water are interrelated in the maintenance of leptospirosis, and in dry zones a rat that elsewhere is highly infective may be of little importance in spreading the organisms. Other factors of importance, in so far as they have a marked influence on the viability of organisms on the soil surface, are the pH of the soil water and of the soil itself, and the chemical composition of the soil. Conditions for survival are better when the medium is alkaline, and it may be the relatively high acidity of the soil in the ricefields that accounts for the ineffectiveness of *R. argentiventer* in transmitting the disease to man. As human infection is by direct contact with rat urine or by drinking contaminated water, the commonest environment for the spread of *Leptospira* from rat to man, apart from infection acquired in houses, consists of artificial clearings made near pools and streams in wooded areas.

SOIL-TRANSMITTED HELMINTHS

As many as 200 000 *Ascaris lumbricoides* (roundworm) eggs, 50 000 hookworm eggs, and 50 000 *Trichuris trichiura* (whipworm) eggs may be contained in the average stool from an individual harbouring a pair of worms of each of these species. In China, a recent survey found *Trichuris* to be ubiquitous, infection rates for *Ascaris* to be 30-97%, and those for hookworm 30-90%. In Mauritius, hookworm infection has been found in about half the population and in 88% of people with anaemia (which is very common on the island); while infection rates for *Ascaris* and *Trichuris* were 32% and 40%. These rates are paralleled elsewhere, especially in the less developed tropical and subtropical countries.

In terms of disease, these soil-transmitted helminths have an effect that is not always easy to pin down. Ascariasis has been stressed as a cause of disease and death among children, and according to one authority takes third place among causes of death in a highly endemic area in Ceylon. In certain conditions it may cause pulmonary disease among people of all ages. Trichuriasis is much less frequently reported, but is common in a clinically severe form in the West Indies, Central America, India, South Africa, Chile, the Philippines, and the south-eastern USA. Hookworm disease is well known for the anaemia it causes and its debilitating effects. All occur commonly among people in the less developed countries who are on or near the borderline of malnutrition. According to Professor P. C. Beaver, in a new WHO publication surveying soil-transmitted helminths and their control, these worms, from the standpoint of their influence on individual health and group productivity, rank highest among all the helminths, and their prevalence in different communities serves as an index of socio-economic status.[1]

Why are these worms so widely distributed? The soil serves as a sort of " intermediate

[1] Beaver, P. C. (1961) *Control of soil-transmitted helminths*, Geneva, p. 7 (*World Health Organization: Public Health Papers*, No. 10). In the footnotes that follow, this publication is referred to simply as *Control of soil-transmitted helminths*.

host ", receiving the non-infective stages, providing the conditions in which development to the infective stage can take place, and protecting the developed infective stage until infection can take place. The soil-transmitted worms require specific types of soil and tolerate relatively narrow limits in the range of physical conditions within the soil. But the climate and soil they need are essentially the same as those needed by man himself wherever he is largely dependent upon locally grown wild or crop plants for his food; hence their wide distribution.

Given the life cycle of these worms and the way in which infection is transferred, control is theoretically easy. Kill the worms in the infected individual, prevent faecal contamination of the soil, render the soil unsuitable for the development of infective stages, or keep people away from infective soil until infection is lost, and transmission will cease. Unfortunately, as Beaver remarks, " in situations where the control of soil-transmitted infections is most needed, each of the theoretically possible approaches to control is obstructed by hurdles which are at present almost insurmontable ".[2] This is illustrated by the disappointing results obtained against hookworm in intensive campaigns between 1910 and 1930 by the Rockefeller Sanitary Commission and International Health Board, campaigns based on a policy of survey, treatment, and installation of latrines.

So disappointing were these results that a new approach was adopted in the USA in 1940. This approach was based upon certain assumptions. One was that, with the techniques available, hookworm and similarly transmitted infections could not be eradicated from open communities in highly endemic areas where people could not be placed under strict control. Another was that light infections are in general well tolerated and that the mere presence of infection is not in itself evidence of impairment to health and productivity. A third was that infection can be transmitted only if conditions of soil, moisture, and temperature are favourable, and, since these conditions vary from place to place, not all communities without sanitation suffer equally from damaging infections. Yet another was that damaging infections are detectable among those less damaging. The last was that, while infection is frequently not eradicated by the anthelminthics available, it is relatively easy as a rule to reduce the worm burden to tolerable levels.

A control programme based on these assumptions, it was argued, would concentrate on the communities where damaging infections are most prevalent and on the individuals whose infections contribute most to the condition of suboptimal health. It could be effective only if carried out as a co-ordinated part of a comprehensive programme of community improvement.

This selective type of programme was first instituted in Georgia, USA. Public health workers were obviously not over-anxious to adopt a programme that did not affect the total infectiousness of the population or reduce the possibility of reinfection; but analysis of the costs, results, and alternatives has led them to accept it, and it has continued since in substantially the same form. In other parts of the world the methods of control used are those of the Rockefeller hookworm campaigns. In many places, however, practically nothing is being done in any organized way, on the grounds that eradication is impossible and that in due course, with improvements in living standards, the problem will solve itself.

It can be accepted without demur that, when the individual and the community are provided with adequate food, housing, and sanitation, the problem of infection with the soil-transmitted worms will disappear. But clearly it will take time for communities in those less developed areas where these infections are prevalent to attain adequate standards, and among these communities the helminthiases constitute an enduring problem, which may at times be aggravated by social and economic maladjustments.

Control methods

Present control methods emphasize sanitation, treatment, and the wearing of shoes. All have their defects. In communities with living

[2] *Control of soil-transmitted helminths*, p. 8.

standards at or near subsistence level the installation of latrines has proved to be a failure. Durable latrines are costly to install and maintain; often they are inconveniently located and offensive; only rarely are they confortable or in any way inviting; and sometimes they are a source of contamination of their immediate surroundings. Moreover, they do not reduce contamination of the soil by children in the age group 1-3, by whose indiscriminate defecation ascuriasis and trichuriasis may remain endemic even when the rest of the community (or most of it) has reached the stage of flush toilets.

Disinfection of food, faeces, and the soil looks to be a possible method of breaking transmission of infection. Chemical soil disinfectants could perhaps be used to a limited extent around habitations, and drainage and breaking up the surface of the soil to hasten desiccation of infective eggs and larvae, or turning the soil to put infective eggs deep below the surface, have been recommended. The reliability of these methods is doubtful, disinfectants cost money and would have to be used on a wide scale, and the task of persuading the people concerned to do the digging would be formidable. Nor would it be any easier, in areas where this is the practice, to persuade them to stop using faeces as fertilizer in the form of night soil or as irrigation sewage. Proper storage of night soil and suitable methods of composting kill even the most resistant helminth eggs, but are often impracticable and would anyhow require rigid regulation and supervision. Is it possible, then, to disinfect food ? Many of the disinfectants currently used are useless for fresh fruit and vegetables eaten raw. Potassium permanganate does not kill helminth eggs. Full-strength vinegar is quickly lethal to amoeba cysts, other enteric organisms, and hookworm larvae, but does not affect *Ascaris* eggs. Brine, syrup, natural acids, oils, and spices are ineffective with *Ascaris* eggs (though garlic and mustard oils apparently kill both *Ascaris* and hookworms in the infective stages). The only all-purpose disinfectant is aqueous iodine, which is also lethal to all known types of enteric organisms. But even if the people affected could be supplied with enough aqueous iodine for their needs, could they be persuaded to use it?

Treatment with drugs offers no promise of great success except with ascariasis, because the drugs available for ancylostomiasis and trichuriasis usually expel some, but not all, of the worms. Moreover, mild infections with the intestinal nematodes are well tolerated. It would be exceedingly difficult to persuade fit people suffering from mild infections to submit to repeated unpleasant treatment with drugs; but if they do not, infection will continue.

Shoes are often recommended, but without a realistic appreciation of their disadvantages. Apart from the fact that suitable shoes would cost more than the people who need them can pay, they would almost certainly be taken off in the wet areas where hookworm transmission is worst, both to preserve the shoes and to prevent the discomfort of sodden footwear. Their use would also mean breaking the habit of walking barefoot—an insuperable or well-nigh insuperable task in hot, poorly developed countries where the habit is, given the conditions, both ingrained and sensible.

A promising approach

The most promising approach, in Beaver's view, would seem to be through the application of ecological principles. Some of the numerous essential environmental factors in infection with the soil-transmitted helminths are still unknown, as is shown by the discontinuous distribution of infections within broad endemic areas, infection not occurring in places where it would normally be expected to occur. Nevertheless, the individual requirements of each species in each of its developmental stages have been closely studied and many are well known, so that it is possible to recognize the environmental conditions that are favourable for transmission and those that are not. The objective would then be to make the conditions unfavourable for transmission. But:

"In most types of long-established communities, particularly those in which the use of open defecation sites is a fixed pattern, attempts to control transmission may not be feasible by any means. The best that

can be done in assisting such communities is to direct control efforts towards the diseases rather than the infection and its transmission." [3]

In these communities the methods used will be those elaborated in the USA around 1940, care being taken to determine the relative importance of the worm infections in the community under treatment (so as not to waste time and money on controlling a relatively minor infection).

In newly established communities, however, environmental conditions could be made impossible for parasites. In New Orleans, ascariasis and trichuriasis have been eliminated as public health problems in new housing projects for families transferred from former slum areas, chiefly by making the surface of outside areas where children are permitted unsuitable for the incubation of the infective stages of helminths, but also by arranging the housing units so that indiscriminate defecation, disapproved of by the community in general, cannot occur unobserved. (There are of course flush toilets.) Similar features serving as barriers to transmission of soil-transmitted helminths could almost certainly be included in the construction of all villages for displaced or re-located families. Environmental "conditioning" to interfere with the transmission of infection could be a part of improvement programmes for old communities.

[3] *Control of soil-transmitted helminths*, p. 29.

REHABILITATION IN LEPROSY

Over ten million people in the world—it is estimated—suffer from leprosy. Less than 5% can be accommodated in existing institutions; most live in their own homes, and probably not more than 20% receive treatment of any kind. In 1959 a WHO Expert Committee on Leprosy [1] put the proportion with some disability at about 25%, but this estimate is undoubtedly conservative. Much could be done for the rehabilitation of this group that is not being done at present.

Many leprosy deformities and disabilities would not occur at all if treatment started the moment the disease is diagnosed. At the present time, however, only a small proportion of patients receive any treatment at all. But much can be done to help those who already have deformities and disabilities. Just how much is shown in the report, recently published, of a Scientific Meeting on Rehabilitation in Leprosy held in November 1960 in Vellore, India, under the sponsorship of WHO, the Leonard Wood Memorial, and the International Society for Rehabilitation of the Disabled (with assistance from the National Institute of Neurology and Blindness of the US Public Health Service, the Bureau of Medicine and Surgery of the US Navy, and the Christian Medical College, Vellore).[2]

Two major points emerged during the meeting. One was that important advances have recently been made in the field of rehabilitation of leprosy patients by scientists whose main interests and experience are in different but related fields. The other was that problems in the pathology and treatment of deformities very similar to those occurring in leprosy have been or are being solved through the use of techniques already known and in common use in medical schools and other research centres. The Scientific Meeting concluded that:

"... leprosy research should no longer be carried out merely in institutions confined to leprosy and by leprosy specialists who could not have the assistance of basic scientists and experts in other fields ... much more rapid progress in rehabilitation could be made if leprosy were studied and treated along with other diseases in centres where a wide range of medical scientists would be available." [3]

[1] *Wld Hlth Org. techn. Rep. Ser.*, 1960, **189**, 21.

[2] *Wld Hlth Org. techn. Rep. Ser.*, 1961, **221**.

[3] *Wld Hlth Org. techn. Rep. Ser.*, 1961, **221**, 4.

A prerequisite to the study of the problem of disabilities and deformities in leprosy is knowledge—knowledge not only of their prevalence but also of the mode and time of their onset and their relationship to the stage of the disease and its treatment, as well as to occupation at the time of onset. Knowledge is also required about the effectiveness of drug treatment in the prevention or limitation of nerve damage and its sequelae.

Mycobacterium leprae attacks the nerves, particularly in patches of skin all over the body—when superficial loss of sensation occurs—and in some mixed nerve trunks at definite sites of predilection in the limbs and face. Most of the serious disabilities in leprosy are secondary to the involvement of these nerves, which have certain common characteristics. Thus, for example, they occupy a superficial position, are liable to trauma and pressure, are close to bones and tendons, tend to stretch on movement of joints, possess fibrous bands and tunnels distal to the point of involvement, and have a temperature lower than that of the body. Involvement of the sites of predilection—at the elbow, wrist, knee, ankle, and zygoma—is usually associated with swelling of the nerve concerned, and there is evidence that ischaemia secondary to the swelling may be the immediate factor precipitating paralysis. Splinting of the affected limb or the use of corticosteroids (or both) during an acute reaction may prevent damage to the nerve trunk.

Deformities of hand and foot

Leprosy may cause deformity of the hand either by paralysing the motor nerves or by infiltration of the tissue during reactive phases. In this way claw hand, loss by the thumb of its power of abduction and opposition, wristdrop, and contractures may result. Or *Myco. leprae* may invade the bones, which may become soft and fracture. Secondary deformity may arise from lack of treatment, neglect, or injury to extremities suffering from motor or sensory nerve loss, resulting in contractures of the skin on the flexor aspect of paralysed fingers or thumb tip or of the thumb web. Sepsis following injury to anaesthetic parts may add its quota to the damage. Treatment is physiotherapy (oil massage, wax baths, and exercises), surgery, if needed (operations to deal with the claw hand, the paralysed thumb, the contractures and radial paralysis), and measures to deal with the sepsis.

In the foot, the main deformities are drop foot and clawing of the toes, and plantar ulceration is a common complication. Transplant operations take care of the deformities.

Trophic ulceration

Trophic ulceration commonly results from tissue damage in the foot, the sensory deficit leading to necrosis of the deep tissues and ulceration in well-defined areas. It is not a specific lesion of leprosy, but a sequel of damage to the nerve, and the major cause, in the opinion of the Scientific Meeting, is the mechanical effect of the shearing strain and abnormal pressure occurring during walking on a neuropathic foot—hence the sites of predilection at the points of heel impact, of flexion across the walking sole, and of push off at the end of the stride. Often ulceration is associated with Charcot's joint, this also being an expression of sensory deficit.

The first ulcer is the crucial one and should be avoided at all costs because of the infection to which it opens the way. If it occurs, it can be treated at home by rest in bed for 4-5 weeks, or, after a preliminary period of 3-4 days in bed to reduce oedema and eradicate secondary infection, by the use of footwear with a rigid sole. The recurrent ulcer needs special care, sometimes surgical. Where there are orthopaedic and plastic units in general hospitals, patients with plantar damage should be admitted for treatment; there is no longer any justification for special centres for these leprosy patients. Where there are no orthopaedic or plastic units, many advanced cases of plantar ulcer will be incurable and the foot may have to be amputated; but the report draws attention to the spectacular results that can be achieved by the intelligent and persistent use of plaster casts and footwear with rigid soles. Above

all, constant inspection of feet should be carried out so as to catch the lesion before it develops into an ulcer and treat it then prophylactically. As the Scientific Meeting says: "... if present knowledge were properly applied, plantar ulceration should never occur as a complication of leprosy." [4]

Bone changes and absorption

Bone changes in leprosy may be of three types: specific osteitis leprosa, non-specific bone absorption, and osteoporosis. The first is seen in a very small percentage of leprosy cases, and has responded (with sclerosis and thickening of the cortex) to treatment for about a year with sulfones. Non-specific bone absorption is much more common, and is associated with several factors, chiefly nerve lesions, trauma, and sepsis. Nerve lesions by themselves will not produce bone absorption, but with trauma, stress, or infection may. The stresses and minor traumata that would not affect ordinary people without disease of the nervous system may have an entirely different effect on people with leprosy and nerve lesions. There are several reasons for this: one is that the stress applied safely over a large area may not be safe when applied over a small area—thus, muscle imbalance with claw fingers tends to concentrate the stress on the finger tips only. Another is that people without sensation in their hands tend to grasp very much harder than necessary. Yet another is that the subcutaneous scarring resulting from a series of minor injuries to the pulp tissues causes a fibrous replacement of these normally vascular tissues and a development of foci of aseptic necrosis that may involve the bones and lead to absorption. Sepsis accompanied by sensory loss may have the same effect. The third possible change, osteoporosis, is seen in only a small percentage of cases, usually in association with local disuse due to pain, swelling, or paralysis, or with general disuse due to old age or debility.

Specific osteitis leprosa can be healed completely and deformity prevented by immobilization of the part affected in a position of function during periods of pain and swelling. Non-specific absorption is averted by immediate attention to minor traumata and ulcers; if injuries are dealt with at once and infection prevented or stopped as soon as it begins, bone absorption will not develop, or if it develops will be arrested. Care of plantar ulcers is especially important.

Facial deformities

Most deformities of the face occur in lepromatous leprosy, except for lagophthalmos, which is commoner in tuberculoid leprosy. The mucous membrane of the nose is involved early, ulceration leading to exposure necrosis of the underlying cartilage and bone and so to the collapse of the nose.

There is no loss of skin in leprosy, so these lesions lend themselves readily to reconstructive surgery. The plastic operations required can admittedly be carried out only in a properly staffed and equipped centre.

Damage to the eyes

" Blindness," says the report, " a serious disablement for the average person, is a disaster to the leprosy victim who has lost sensation in his hands and feet." [5] The conditions most likely to lead to blindness in leprosy are severe lagophthalmos (particularly in the presence of corneal insensibility), and the irido-keratoscleral group of complications due to direct lepromatous infiltration or allergy or both. The commonest single cause of blindness is iritis.

Since the introduction of sulfone therapy, the incidence of ocular damage seems to have declined, though statistically there is no proof of this. For lagophthalmos operation is possible, and tarsorrhaphy will protect the cornea and preserve the sight until a temporalis transfer can be done. Involvement of the cornea, sclera, or iris can be met by treatment with 1% atropine and the corticosteroids. Prevention is better than cure, however, and ideally every hospital for

[4] *Wld Hlth Org. techn. Rep. Ser.*, 1961, **221**, 17.

[5] *Wld Hlth Org. techn. Rep. Ser.*, 1961, **221**, 23.

leprosy patients should have the services of a trained ophthalmologist. If one is not available the physician in charge should make himself acquainted with the investigation and care of the eye.

Rehabilitation

A WHO Expert Committee on Leprosy defined rehabilitation as follows:

" By rehabilitation is meant the physical and mental restoration, as far as possible, of all treated patients to normal activity, so that they may be able to resume their place in the home, society, and industry. To achieve this, treatment of the physical disability is obviously necessary, but it must be accompanied by the education of the patient, his family and the public, so that not only can he take his normal place, but society will also be willing to accept him and assist in his complete rehabilitation." [6]

The Scientific Meeting emphasized that the problem of deformities in leprosy is not basically different from that of deformities from other causes; the same principles apply in rehabilitation, reconstructive surgery, and re-education. Rehabilitation services and centres should therefore be the same for all disabilities, special centres for leprosy being justified only by special circumstances.

There are nevertheless certain difficulties peculiar to the rehabilitation of leprosy patients. The public fears the deformities, thinking that they indicate infection. Patients fear that deformities of the feet, hands, and face are inevitable and cannot be prevented or cured. The patient with loss of sensation may not be fit for ordinary work or employment. To overcome these difficulties, intensive education of the public and the medical profession is needed, with emphasis on the points that leprosy is curable and that residual deformities do not mean that it is still active. Education is required on the prevention of deformities; prevention, along with treatment and rehabilitation, is an inseparable part of any programme dealing with leprosy. For the correction of the deformities, there should be a physiotherapy unit and reconstructive surgical centres. To provide reemployment there should be services to place the patient in jobs, vocational training units, sheltered workshops for those who cannot be independent, and settlements to provide permanent homes and work when necessary.

If medical services are adequate and the endemicity of leprosy is low, the existing rehabilitation services should be used. If trained personnel is in short supply, the rehabilitation programme should be built up around a good surgical reconstructive unit. But if existing medical services are not yet fully adequate, training is required to provide the necessary personnel. Every leprosy worker should be taught the basic principles of rehabilitation; auxiliaries should be taught physiotherapeutic methods; surgeons should learn reconstructive techniques; and social workers should know what special methods exist for dealing with the limitations imposed by deformity.

The Scientific Meeting closed its report with a quotation that admirably summarizes the views of the participants and deserves to be reproduced in full:

" Too often it is assumed that rehabilitation should begin only after cure of the disease. In some diseases that sequence may be logical. In the case of leprosy, most of the psychological harm is done in the first few months after the diagnosis is made. It is then that despair strikes. It is then that the patient's whole world crumbles away. It is then that he begins to feel persecuted and to feel that no effort is worth while. That is the root of apathy, and it is a root that deepens and ramifies widely. *Rehabilitation must start on the day of diagnosis*, or as soon thereafter as the social worker can introduce the patient to the new world that for such a short time must replace his old, until he is ready to return, freshly equipped and with a welcome awaiting him." [7]

[6] *Wld Hlth Org. techn. Rep. Ser.*, 1960, **189**, 20.

[7] *Rehabilitation literature*, 1960, **21**, 234.

Notes and News

Health services in small factories

A Conference on Health Services in Small Factories was convened jointly by the WHO Regional Office for Europe and the International Labour Organisation (ILO) at Dun Laoghaire, Dublin, Ireland, from 8 to 16 May 1961. The 40 participants in the Conference included medical officers, officials from Ministries of Labour, and representatives of employers' and workers' organizations. The countries represented were: Austria, Belgium, Bulgaria, Czechoslovakia, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Norway, Poland, Spain, Sweden, Switzerland, Turkey, United Kingdom, USSR and Yugoslavia.

Between 80% and 90% of factories in most European countries employ less than 100 workers. Of the 220 000 factories in the United Kingdom, 150 000 employ 10 or fewer workers; more than a million people work in factories employing 25 or less, the number of such factories having nearly doubled in the past 25 years. In Italy, 95% of industrial plants have less than 100 workers, in Switzerland 90%, in Belgium 96%, in Denmark 99%, and in Sweden 92%.

While the problem of providing health services in large factories in Europe is well on the way to solution, even though different methods are used in different countries, the smaller factories in most countries of Europe do not have health services on or near their premises. The risks to which their workers are exposed are certainly not less than in the larger factories and in many cases are greater, since the working environment in terms of atmosphere, ventilation and layout is considerably poorer. Instruction in special hazards and supervision and training in handling dangerous materials, such as toxic chemicals or radioactive isotopes, are less efficient as a rule than in large factories. While periodic medical examinations are compulsory for workers in certain dangerous trades, there are usually no medical facilities within the factory beyond a first-aid box. The foreman is often in charge of this but he is usually untrained in health matters.

There was general agreement among the participants in the Conference that the provision of health services to these small undertakings is a real and urgent need, but there was less agreement about how to provide them. Among the difficulties are the diversity and dispersion of the factories, which may be scattered over a considerable area. It is feasible for a doctor to provide health care for 3000 workers in one factory, but not for 30 factories each with 100 workers. The cost of an autonomous health service is prohibitive for the small employer, and health hazards are often not understood or appreciated by employers or workers.

The Conference discussed schemes now being tried out in various parts of Europe to provide health services for small factories. Four main tendencies are discernible.

In Czechoslovakia and in eastern Europe as a whole, these occupational health services are provided as part of a general programme of health protection covering both curative and preventive medicine and organized by the State.

In France, the Ministry of Labour is responsible for implementing general regulations on hygiene and security. Employers are obliged to set up health services which, for the majority of small factories, take the form of inter-factory services. The responsibilities of the physicians in these services are, in principle, the same as those of all industrial medical officers, i.e., they are entrusted with preventive medicine, treatment being provided only in emergencies and for accidents.

In Italy, health services in small factories are mainly the concern of the National Institute for the Prevention of Accidents, which has some 30 branches scattered throughout the country.

In the Netherlands, the United Kingdom and Scandinavia, inter-factory occupational health services are provided on a voluntary basis, generally by means of a non-profit-making body on which doctors, employers and workers are represented. Organizations of this type show a tendency to grow in size and popularity as new

factories join the service, and to extend to other areas. Their role is mainly preventive, but in some cases they provide treatment.

In a separate statement, the employers' representatives attending the Conference declared that, while agreeing that medical services in small factories should be essentially preventive, they nevertheless felt that these services should be encouraged to provide other treatment as well as emergency treatment. The advantages to be gained are a more efficient use of manpower, an increase in production (since workers would not lose so much time visiting hospitals for treatment), and improved morale. They stressed their opinion that such services should be organized on a voluntary basis.

The representatives of the workers' organizations welcomed the important developments now taking place in the field of health supervision for their members, though many of them considered that progress in this field is still too slow. It was their opinion that, by accepting the goal of occupational health services for all workers, the ILO has opened an important chapter in the history of occupational health.

Completion of rehabilitation programme in Morocco

The international programme of treatment and rehabilitation for some 10 000 victims of poisoning by food oil in the Meknès area of Morocco has now been completed. In a special statement on the subject, Dr M. G. Candau, Director-General of WHO, says:

"The completion after eighteen months of the international phase of the rehabilitation programme for Moroccan victims of paralysis due to food-oil poisoning is a cause of satisfaction to all concerned in this undertaking—and in particular the Moroccan Ministry of Health, the League of Red Cross Societies, and the World Health Organization.

"When in September 1959 an increasing number of cases of paralysis of unknown origin appeared in Morocco, the Government urgently asked WHO assistance in establishing the cause. Within three days WHO experts began work on the spot, and together with the Moroccan health authorities, they quickly established that cooking oil adulterated with a mineral oil containing tri-orthocresyl-phosphate was responsible. Subsequently WHO entered into partnership with the League of Red Cross Societies in mobilizing the international assistance needed for a vast rehabilitation programme for the victims of all ages.

"It is gratifying to think that Morocco will have benefited not only from the rehabilitation of many thousands of citizens who would otherwise have been incapacitated to a greater or less degree, but also from the training given by international experts to Moroccan medical staff who were able to assist the Red Cross personnel and can now take over on their departure and continue giving the long-term treatment still required by certain severe cases.

"Great praise is due to the doctors, physiotherapists, nurses and other health staff, most of them provided by Red Cross and Red Crescent Societies, who have so unsparingly given their services and have worked alongside the Moroccan health authorities to carry out the programme which is now completed. The World Health Organization is most happy to have been associated with this endeavour."

Radiation protection in the Americas

A Radiation Protection Unit has been established by the Pan American Sanitary Bureau (PASB), which acts as the WHO Regional Office for the Americas. It will help the countries of the Region to set up education programmes in radiation protection; encourage the use of radioisotopes in medicine; foster the establishment of international isotope centres for the training of both national and international personnel; promote research; and help draft appropriate legislation.

A number of international organizations besides PASB/WHO are helping the countries of the Americas to start radiation protection programmes. They include the International Atomic Energy Agency (IAEA), the Inter-American Nuclear Energy Commission (IANEC) of the Organization of American States, the International Labour Organisation (ILO), and the Food and Agriculture Organization of the United Nations (FAO). IAEA and IANEC award fellowships and organize courses and symposia on the peaceful uses of atomic energy, while ILO has drawn up a model code for the safe use of ionizing radiation in industry. FAO has carried out or sponsored several studies on

the effect of radiation on food production and living conditions.

The new PASB unit will work closely with all these organizations. A paper on education for radiation protection and the use of isotopes will be presented by PASB/WHO at a Regional Seminar on Nuclear Energy for Latin American countries, to be held in November 1961 at San Carlos de Bariloche, Argentina, under the sponsorship of IAEA and IANEC.

Honorary degree for WHO Director-General

Dr M. G. Candau, Director-General of WHO since 1953, was recently awarded the honorary degree of Doctor of Laws by the University of Michigan. The degree was conferred during the University's 117th commencement, held at Ann Arbor on 17 June 1961. The citation was as follows:

" MARCOLINO GOMES CANDAU, Director-General of the World Health Organization. In these times, when rapidly contracting communications seem almost daily to increase the number of hostile collisions among men, the ministry of Dr Candau is a heartening testimony to the potentiality for good in close human interdependence. Under his leadership the nations of the world, new and old, have notably extended and diversified their collaboration in the health sciences. Most recently, he has helped to stem the deterioration of health and medical services occasioned in the Congo by sudden political change: calling upon his superior administrative gifts, his almost legendary charm, and his extraordinary personal reserves of poise and courage, he won general acceptance for himself and his staff in a land rife with animosities. This achievement, differing from his daily accomplishments only in its heightened dramatic quality, fittingly represents the public life of the wise and good man upon whom the University now confers the degree Doctor of Laws."

Entomology in malaria eradication

The contribution of entomology to the worldwide malaria eradication campaign was the subject of an inter-regional meeting convened by WHO in Alexandria, Province of Egypt, United Arab Republic, from 22 to 27 May 1961. The meeting was attended by senior entomologists from five WHO regions and presided over by Dr. M. A. Farid, Senior Public Health Adviser (Malaria) at the WHO Regional Office for the Eastern Mediterranean.

The topics discussed included the latest field and laboratory investigations on the vectors of malaria, their susceptibility and resistance to insecticides, their breeding, resting and biting habits, their seasonal prevalence, etc. An intimate knowledge of vector behaviour and reactions to insecticide spraying is of the highest importance in planning and timing malaria eradication campaigns, in order to estimate whether the interruption of malaria transmission can be achieved by residual spraying of premises alone, or whether this must be supplemented with other measures such as larviciding or drug administration.

The participants in the meeting subsequently lectured at an advanced two-month course, held at the Malaria Eradication Training Centre in Cairo, for malaria eradication entomologists from Cambodia, Ethiopia, Ghana, India, Iran, Jordan, Nepal, Pakistan, Saudi Arabia, the Somali Republic and Swaziland.

People and Places

PASB radiation protection appointments

Dr Irvin M. Lourie has been appointed Chief of the newly established Radiation Protection Unit of the Pan American Sanitary Bureau (PASB), which acts as the WHO Regional Office for the Americas (see page 353). Dr Lourie, who recently completed a year's study leave at the University of Rochester, N.Y., in preparation for his new post, was previously Chief of the Fellowships branch of the Pan American Health Organization for six years. He also

served with the European Office of WHO from 1947 to 1949.

Mr Thomas E. Shea, jr, has been appointed Radiation Protection Officer with PASB, and will serve as assistant to Dr Lourie. Mr Shea holds degrees in chemistry from La Salle College, Pennsylvania, and in industrial hygiene from the University of Pennsylvania, and has done advanced studies at the Harvard School of Communications and the Oak Ridge Institute of Nuclear Studies. A commander in the US Navy from 1943 until his PASB appointment, Mr Shea served as Executive Secretary of the US Atomic Bomb Casualty Commission founded in 1946 to carry out long-range studies of the biological and medical effects of the atomic bomb on man.

Environmental sanitation in the Americas

Mr Jorge Guzmán Trigueros, of El Salvador, has been appointed sanitary engineer with the Pan American Sanitary Bureau (PASB), which acts as the WHO Regional Office for the Americas. One of his principal duties will be to ensure liaison between PASB and the Inter-American Development Bank and other international banking institutions, in matters concerning loans to governments for the improvement and expansion of water supply and sewerage services throughout Latin America.

Mr Guzmán graduated from the National Military Academy of El Salvador in 1931. He received his degree in civil engineering from the University of Ghent, Belgium, in 1936 and attended a post-graduate course in sanitary engineering at Harvard University in 1944-45. From 1942 to 1944, Mr Guzmán was chief municipal engineer in San Salvador, and from 1945 to 1951 he was chief engineer in El Salvador for projects sponsored jointly by the Salvadorian Government and the US International Cooperation Administration. From 1952 to 1956, he was Director-General of the " Valle de la Esperanza " project in El Salvador, supervising the physical, economic and social reconstruction of an area destroyed by earthquake. During this project he was responsible *inter alia* for the establishment of 25 new rural water services and the rebuilding and improvement of water services in three communities with a combined population of 25 000. From 1956 until 1960 he was Under-Secretary of Public Works, El Salvador.

Industrial hygiene

Mr John J. Bloomfield has been appointed regional consultant in industrial hygiene with the Pan American Sanitary Bureau (PASB), which acts as the WHO Regional Office for the Americas.

Mr Bloomfield's duty station is Santiago, Chile, where he will help the Chilean Government to develop an institute of occupational health to serve as a training centre for workers from all parts of Latin America. He will also serve as consultant in occupational health to the various governments in the Americas.

Mr Bloomfield holds an engineering degree from the University of New Hampshire, and has done postgraduate studies in physical chemistry at the University of Pittsburgh and in public health at Yale University. From 1920 to 1923 he was a research engineer with the US Bureau of Mines, and from 1923 to 1950 he was assistant chief of the Division of Industrial Hygiene, US Public Health Service. From 1950 until his PASB appointment, he served with the US Public Health Service and the US International Cooperation Administration as regional consultant in industrial hygiene for Latin America.

Nurse for PASB field office

Mrs Zilda Carvalho Hughes has been appointed nursing consultant at the El Paso (Texas) Field Office of the Pan American Sanitary Bureau (PASB), which acts as the WHO Regional Office for the Americas. She will help to co-ordinate nursing work on both sides of the 1500-mile border between the United States and Mexico—there are four states on the Mexican side of the border and six on the US side.

A native of São Paulo, Brazil, Mrs Hughes studied health education at the University of São Paulo and nursing at the University of Toronto. She has done post-graduate studies in education, and was awarded the degree of Master of Public Health by the Johns Hopkins University in 1950.

After holding teaching and supervisory posts at the University of São Paulo and in the Republic of Panama, Mrs Hughes was Assistant

Director of a survey of nursing resources carried out in Brazil under the sponsorship of PASB and the Rockefeller Foundation. Before her present assignment, she was a member of a PASB/WHO team which is helping to expand public health services in Paraguay.

Training of sanitarians

Mr I. W. Beaton, of the United Kingdom, has been appointed WHO sanitarian tutor in Afghanistan for a period of two years, and will take up his duties at the end of October 1961. He will advise and assist in the development of the academic and field training programme at the School of Sanitarians, Kabul.

Mr Beaton has had more than twenty-five years experience of sanitation work and hygiene training. His last appointment was as sanitarian for the Federation of Rhodesia and Nyasaland at Mzimba, Nyasaland.

Insecticide testing

Mr J. A. Dawson, of the Tropical Products Institute, Department of Scientific and Industrial Research, London, has been appointed consultant on chemistry to the WHO Insecticides Testing Unit, Nigeria, for a period of two months.

A graduate of the University of London, Mr Dawson has collaborated with WHO for several years on matters relating to the chemistry and specifications of pesticides and on the development of compounds that might be substituted for DDT in malaria eradication programmes.

During his present assignment, he will take part in studies on the efficacy of DDVP (0,0-dimethyl-2,2-dichlorovinyl phosphate) as a residual fumigant and in further studies on the toxicology of organophosphorus insecticides in mosquito control.

Headquarters appointment

Dr Marshall Laird has been appointed Scientist (Biologist) in charge of the Environmental Biology unit, Division of Environmental Sanitation, WHO Headquarters.

Dr Laird was born in Wellington, New Zealand, and was educated at Victoria University College, Wellington, New Zealand, receiving a B.Sc. in Zoology and Botany in 1943, an M.Sc. in Zoology in 1946, a Ph.D. in Parasitology in 1949, and a D.Sc. in 1954. From 1943 to 1954, he was an entomologist in the Royal New Zealand Air Force; since then he has been lecturer in parasitology at the University of Malaya, Singapore, and Associate Professor of Parasitology at Macdonald College, McGill University, Quebec, Canada. For his research work in ecology, he was awarded the Royal Society of New Zealand Hamilton Research Award in 1951, and the New Zealand Association of Scientists Research Medal in 1952. Dr Laird has previously undertaken WHO assignments concerning the application of biological agents for mosquito control, and methods for aircraft disinsection.

Review of WHO Publications

Bulletin of the World Health Organization, 1961, Volume 24, Number 4-5 (pages 399-678). Price: £1, $4.00, or Sw. fr. 12.—.

The papers in this issue of the *Bulletin of the World Health Organization* well illustrate the interrelationship between many aspects of malaria eradication and the control of numerous other insect-borne diseases.

The effectiveness of malaria eradication on the African continent is greatly influenced by the large-scale movements of population which take place, the majority of them being inter-territorial. There has so far been little information on the degree, the seasonal periodicity and the direction of the main population movements, and a report by Mansell Prothero in this issue throws much light on this subject, in which the help of anthro-

pologists and social geographers is of vital importance for the proper planning of malaria eradication programmes.

Three papers—by Armstrong and Bransby-Williams, Hamon et al., and Ungureanu et al., respectively—report on physiological observations or research on anopheline vectors of malaria and cover the maintenance of laboratory colonies of mosquitos (with observations on the effect of temperature on mortality), the assessment of the physiological age of anopheline females, and the effect on the susceptibility to insecticides of the manner in which anophelines make contact with toxic substances through their legs.

Two articles by Burgess & Bray and by Charles deal with chemotherapeutic field trials in West Africa, demonstrating the possibilities of new drugs or of various dosages of antimalarials when used in malaria eradication programmes. A note by Gunders assesses the value of a combination of two drugs on the development of malaria parasites in the mosquito and shows the additive effect of these drugs. Another by Shute & Maryon is concerned with the infectivity to mosquitos of patients with induced malaria; this investigation has a bearing on practical problems of surveillance in the terminal phase of malaria eradication.

Another paper concerned with the effect of chemical substances in the human body—although not in relation to malaria—is a report by Beheyt et al. on the toxicity to man of an organophosphorus insecticide which, in purified form, has also shown promise for the treatment of various parasitic worms.

The study of cytological characteristics of salivary-gland chromosomes in anophelines has helped in analysing the relationship between species belonging to the European and North American *Anopheles maculipennis* complex. A note by Schreiber & Guedes describes similar research carried out on the tropical subgenus *Nyssorhynchus*.

The occurrence of resistance to DDT or dieldrin or both in many important anopheline vectors of malaria emphasizes the necessity of developing substitute compounds to ensure the success of malaria eradication operations. A valuable study of such compounds has been made with resistant *Anopheles albimanus* in El Salvador by Schoof et al.

As the techniques for evaluating insecticides have become increasingly refined in recent years, so also have the tools for carrying out such techniques. One such tool is the experimental hut used for assessing insecticides applied to its internal surfaces; the design of such a hut has undergone several changes in the past decade or so and a note by Rapley in this issue describes recent improvements.

The WHO test kits for determining changes in the susceptibility of adult and larval mosquitos to various insecticides were originally designed mainly with a view to their use with malaria vectors but they have proved so useful and convenient that studies are under way to develop test kits for use with a wider variety of insects of public health importance. A series of papers—by Fox, Omardeen, and Busvine & Lien—describes susceptibility trials with these kits on vectors of malaria, yellow fever and filariasis in such places as Puerto Rico and Trinidad or their modification for use with bed-bugs, cone-nosed bugs, fleas, lice and the fruit-fly, *Drosophila*. There are also reports on resistance to insecticides in bed-bugs and flies in Zanzibar and on two products capable of overcoming present resistance in the housefly.

One strain of *Aëdes aegypti* from Puerto Rico found by means of the WHO test kit to be resistant to both DDT and dieldrin has been subjected by Khan & Brown to genetic studies to clarify this phenomenon. An account of these studies is given here together with an investigation by Craig et al. of the considerable genetic plasticity of this species generally—a factor which not only accounts in part for the differences in the resistance of this mosquito to insecticides in different parts of the world but also influences its disease transmission and breeding behaviour. The influence of temperature at the time susceptibility tests are made on *Aëdes aegypti* is discussed by Bransby-Williams.

Aëdes aegypti occurs in Fiji as the vector of dengue and Burnett & Ash report on its susceptibility there to insecticides as well as on the susceptibility of three other *Aëdes* species and of *Culex fatigans*, all vectors of filariasis.

Culicines are also studied with respect to their response to DDT larvicidal operations in Israel (Tahori) and their inheritance of autogeny (Krishnamurthy & Laver).

The cockroach is not only a noxious pest in itself but may also negatively influence the acceptance of malaria eradication procedures, in that insecticidal spraying which is effective against mosquitos but not against cockroaches may be viewed with some suspicion by the beneficiaries. Cochran and Grayson present studies on resistance and on cross-resistance to insecticides in *Blatella germanica*.

Years of efforts have brought about the elucidation of the fundamental mechanism involved in the sorption of insecticides on the surfaces to which they are applied, and this has stimulated research on formulations of insecticides which would be less subject, or not subject, to sorption. Papers on this question are presented by Bami, Gerolt, and van Tiel, two of whom report encouraging results in laboratory and field trials with such formulations. However, other field investigations in conditions of malaria endemicity have not given equally promising results. Part of the question clearly remains unanswered and further field investigations are needed to determine the practical influence of sorption in operational programmes. The results should show whether the new resin formulations are indeed satisfactory or whether other factors, independent of the formulation, are at play.

The WHO Expert Committee on Insecticides recently reviewed the relative merits of aerosol particles and vapours for the disinsection of aircraft, pointing out, *inter alia*: [1]

> " Not only is vapour disinsection of aircraft more effective than treatment with aerosols against insect vectors of disease, and hence more acceptable to governmental health authorities, but it can also be used for in-the-air disinsection, thereby eliminating the undesirable delays associated with the current use of aerosols and making vapour disinsection more acceptable to the airlines both from the point of view of facilitation and from that of passenger comfort."

One compound in particular—DDVP—appeared to meet all the Committee's requirements, although it was recognized that further work must be done before vaporization could be universally adopted for aircraft disinsection. A number of research reports on this compound which were submitted to the Committee by Pearce et al., Jensen et al., Schoof et al., Hayes, and Witter et al.—are presented in this issue. It may be expected that if further development work on this and similar compounds is successful, aircraft operations and international quarantine policies throughout the world may be profoundly influenced.

[1] *Wld Hlth Org. techn. Rep. Ser.*, 1961, **206**, 12.

Expert Committee on Biological Standardization : Fourteenth Report (*World Health Organization Technical Report Series*, No. 222), Geneva, 1961, 54 pages. Price: 3/6, $0.60, or Sw. fr. 2.—.

The fourteenth report of the WHO Expert Committee on Biological Standardization [1] marks further progress in the establishment, custody and distribution of international standards and international reference preparations of biological substances. International reference preparations of ristocetin, rabies vaccine, smallpox vaccine and antipoliovirus sera types 1, 2 and 3 have been established or the establishment authorized. Collaborative assays of the international reference preparations or proposed standards of novobiocin, nystatin, oleandomycin, corticotrophin and prolactin are in progress or have been completed, so that international units can now be established and international standards set up (in the case of prolactin and corticotrophin, these will be the second and third international standards respectively). International units have already been established for swine erysipelas vaccine and for anti-streptolysin O.

Studies are in progress on a number of substances with a view to finding suitable material to serve as an international standard. Preliminary results of the collaborative assay of inactivated poliomyelitis vaccine have indicated that an international standard vaccine would serve a useful purpose in reducing the variability of the results of potency determinations between laboratories. None of the materials examined, however, appeared to be entirely satisfactory as an international reference preparation. The assays have demonstrated the possibility of preparing a freeze-dried poliomyelitis vaccine that is antigenic, and work on freeze-drying is continuing.

[1] Members of the Committee: Dr D. G. Evans, United Kingdom; Dr P. de Góes, Brazil (Vice-Chairman); Dr P. Krag, Denmark (Chairman); Dr A. S. Outschoorn, Ceylon (Rapporteur); Dr C. Purananda, Thailand; Dr Soemiatno, Indonesia; Dr J. Tréfouël, France; Dr V. L. Troitski, USSR; Dr W. G. Workman, USA. Representative of the Food and Agriculture Organization: Dr A. W. Stableforth, United Kingdom. Secretariat: Dr N. K. Jerne, WHO (Secretary); Dr C. A. Morrell, Canada (Consultant).

In view of the variety of factors that can affect assays of PPD preparations of mammalian tuberculin, the Committee decided that the existing definition of the International Unit of PPD Mammalian Tuberculin should no longer apply. Sufficient data are not at present available for a redefinition of the unit, and it is recommended that for the present the potency of PPD preparations of mammalian tuberculin should be expressed in terms of International Units of Old Tuberculin, on the basis of assays performed under defined conditions.

The Committee reaffirmed its decision not to change the definition of the International Unit of Penicillin, which for practical purposes may be regarded as equivalent to 0.0006 mg of pure sodium benzylpenicillin or to 0.00056 mg of pure benzylpenicillin acid. The International Unit for Vitamin A has been redefined as the activity of 0.000344 mg of pure all-*trans* vitamin A acetate, and the International Unit for Provitamin A as the activity of 0.0006 mg of pure all-*trans* beta-carotene.

The Committee proposes that WHO should explore with the Food and Agriculture Organization the possibility of nominating a third International Laboratory for Biological Standards to be responsible for the custody and distribution of international standards and international reference preparations that are primarily of veterinary importance. The Committee reiterated the view expressed in an earlier report that national governments should designate National Laboratories for Biological Standards qualified to deal with biological standardization in their own countries.

An annex to the report contains a revised list of International Standards and International Reference Preparations held for distribution at the International Laboratories for Biological Standards in Copenhagen and London.

World Directory of Dental Schools, World Health Organization, Geneva, 1961, 228 pages. Price: £1. 5s., $5.00, or Sw. fr. 15.—.

This publication is reviewed in the article starting on page 338.

Evaluation of the Carcinogenic Hazards of Food Additives: Fifth Report of the Joint FAO/WHO Expert Committee on Food Additives (*World Health Organization Technical Report Series*, No. 220), Geneva, 1961, 36 pages. Price: 3/6, $0.60, or Sw. fr. 2.—.

This report of a Joint FAO/WHO Expert Committee [1] surveys the dangers of cancer from food additives. It was discussed in a general article on the hazards of food additives that appeared in the July number of *WHO Chronicle* (page 245).

Scientific Meeting on Rehabilitation in Leprosy: Report (*World Health Organization Technical Report Series*, No. 221), Geneva, 1961, 37 pages. Price: 3/6, $0.60, or Sw. fr. 2.—.

This report is reviewed in the article starting on page 348.

The Role of Immunization in Communicable Disease Control, by various authors, Geneva, 1961, 120 pages (*World Health Organization: Public Health Papers*, No. 8). Price: 6/8, $1.25, or Sw. fr. 4.—.

This publication was reviewed in the August number of *WHO Chronicle* (pages 294-299).

Control of Soil-Transmitted Helminths, by Paul C. Beaver, Geneva, 1961, 44 pages (*World Health Organization: Public Health Papers*, No. 10). Price: 3/6, $0.60, or Sw. fr. 2.—.

This publication is reviewed in the article starting on page 345.

[1] Members of the Committee: Dr E. M. Boyd, Canada; Professor E. Boyland, United Kingdom; Mr H. Cheftel, France; Professor H. Druckrey, German Federal Republic; Professor A. C. Frazer, United Kingdom (Chairman); Mr H. van Genderen, Netherlands (Vice-Chairman); Dr J. A. Miller, USA; Dr B. L. Oser, USA; Professor L. Shabad, USSR; Dr P. Shubik, USA; Dr A. Tannenbaum, USA; Professor R. C. J. Truhaut, France. Observer invited by FAO: Dr P. E. Johnson, Food Protection Committee, National Research Council, USA. Secretariat: Dr M. G. Allmark, WHO (Joint Secretary); Dr A. G. van Veen, FAO (Joint Secretary); Dr C. Agthe, WHO; Dr R. C. Burgess, WHO; Dr L. Verhoestraete, WHO.

INSECTICIDES AND MALARIA

Population movements and problems of malaria eradication in Africa—*R. Mansell Prothero*

The maintenance of a colony of *Anopheles gambiae*, with observations on the effects of changes in temperature—*J. A. Armstrong & W. R. Bransby-Williams*

Observations sur les méthodes d'évaluation de l'âge physiologique des femelles d'anophèles—*J. Hamon, G. Chauvet & L. Thélin*

Investigations on the contact of the legs of anophelines with resting surfaces and its effect on susceptibility to insecticides—*Ernest Ungureanu, Victoria Crismaru & Eugenia Burghele*

The effect of a single dose of primaquine on the gametocytes, gametogony and sporogony of *Laverania falciparum*—*Robert W. Burgess & R. S. Bray*

Field trials with chlorproguanil in the prophylaxis of malaria in Ghana—*L. J. Charles*

Etude de la toxicité pour l'homme d'un insecticide organophosphoré—*P. Beheyt, A. Lebrun, J. Cerf, J. Dierickx & V. Degroote*

Field tests on the residual effectiveness of deposits of malathion and Bayer 29493 against resistant *Anopheles albimanus* in El Salvador—*H. F. Schoof, Willis Mathis & J. R. Austin*

Resistance of *Aëdes aegypti* to certain chlorinated hydrocarbon and organophosphorus insecticides in Puerto Rico—*Irving Fox*

Susceptibility tests in Trinidad with *Anopheles aquasalis* Curry, *Aëdes aegypti* (L.) and *Culex pipiens fatigans* Wiedemann, using the standard WHO mosquito adult test kit—*T. A. Omardeen*

Methods for measuring insecticide susceptibility levels in bed-bugs, cone-nosed bugs, fleas and lice—*James R. Busvine & J. Lien*

Genetical studies on dieldrin resistance in *Aëdes aegypti* and its cross-resistance to DDT—*N. H. Khan & A. W. A. Brown*

Genetic variability in populations of *Aëdes aegypti*—*George B. Craig jr, Robert C. VandeHey & William A. Hickey*

Influence of temperature during the treatment period on the susceptibility to dieldrin of adult *Aëdes aegypti*—*W. R. Bransby-Williams*

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